COMPUTERS AND AUTOMATION

CYBERNETICS · ROBOTS · AUTOMATIC CONTROL

Vol. 3, No. 4

Processing Information Using a Common Machine Language: The American Management Association Conference, Feb. 1954

... Neil Macdonald

The Concept of Thinking

... Elliot L. Gruenberg

General Purpose Robots

... Lawrence M. Clark

Roster of Organizations in the Field of Computers and Automation (cumulative)

APRIL, 1954

The special character of the application of an electronic digital computer for airborne automatic controls is reflected principally in the input-output units.

MORE THAN 100 TIMES FASTER THAN THE HUMAN BRAIN

The physical quantities defining the state of the system—such as altitude, rate of climb, heading, and other vital information—are measured by instruments whose outputs are usually in the form of mechanical displacements or voltages. These analog quantities are converted into digital numbers that are processed by the computer; it performs in "real" time the computations corresponding to the mathematical representation of the control problem. The results of these calculations are numbers representing the signals used to control the system. These output numbers are converted into the analog-type signals used in the control operations.

At Hughes Research and Development Laboratories, where the subminiature airborne digital computer was pioneered, analog-digital input-output systems have been developed for several applications.

For example, in the conversion of direct-current voltages to binary numbers, the many input voltages are digitalized in sequence by a comparison with a precisely linear saw-tooth waveform, gated once per revolution of the drum to successive inputs. Time intervals are produced which are used to control a gated binary counter. Resulting binary numbers are stored in the memory for subsequent use by the computer. Output binary numbers each control the symmetry of a square wave recorded on a drum channel during the output sampling periods. Reading heads continuously present the waveforms to the respective output channels where they are standardized by regulated-current switch tubes and are filtered to establish the direct-current components. Several such waveforms may be time-shared on a single drum channel by encoding.

A major effort at Hughes is also devoted to adapting electronic digital computer techniques to business data processing and related applications—uses destined for far-reaching peacetime application.

Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

ENGINEERS AND PHYSICISTS

Activities at Hughes in the computer field are creating positions in the Laboratories. Experience in the design and application of electronic digital computers is desirable, but not essential. Engineers and physicists with backgrounds of component development or system engineering are invited to apply.

Address:

SCIENTIFIC AND ENGINEERING STAFF

HUGHES
RESEARCH AND DEVELOPMENT LABORATORIES
Culver City, Los Angeles County California

Input-output units (above) of the Hughes airborne electronic digital computer. (Left) Operation of the pilot's direction indicator is discussed by W. S. Shockency (left), Radar Laboratory, and M. L. MacKnight of the Advanced Electronics Laboratory.

COMPUTERS AND AUTOMATION

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Vol. 3, No. 4 April, 1954

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Editor: Edmund C. Berkeley Advisory Committee: Samuel B. Williams, Herbert F. Mitchell, Jr.

Assistant Editors: Eva Di Stefano, Neil Macdonald, Eugene F. Murphy, Hans Schroeder, F.L. Walker

Contributing Editors: George A.W. Boehm, Grace M. Hopper, Alston S. Householder, Fletcher Pratt

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THE EDITOR'S NOTES

New Magazines. Almost everybody we run into these days says to us "You are going to have some competition -- have you heard? And we say, Yes.

McGraw Hill Book Co., New York, is going to publish a magazine called "Control Engineering". Penton Publishing Company, Cleveland, is going to publish a magazine called "Automation". Reinhold Publishing Co., New York, is going to publish a magazine called "Automatic Control". As we said in January about "Instruments and Automation", imitation is the sincerest flattery. There is no doubt that "Computers and Automation" will have and should have competition in a field as interesting and important as the Second Industrial Revolution. We extend greetings to these three new magazines.

We shall continue to try to make "Computers and Automation" as useful and interesting a magazine as we can possibly manage to. If you like it, please tell your friends; if you don't like what we do, please tell us.

Controversy. We believe in the value of controversy, in the field of computers and automation as well as in all other fields. A controversial subject is an interesting subject, an important one to argue about and seek the truth about, through discussion, investigation, and the clash of different views. It is not necessary to lose one's temper in discussion, but it is necessary that each party in the discussion have his fair chance to express his views, without being called names or having his integrity or loyalty to anybody or anything attacked.

In a fine article "This is the Real, the Lasting Damage" in "The New York Times Magazine", for March 7, John B. Oakes, a member of the New York Times editorial board discusses "the atmosphere of fear in the United States." The illustration at the start of the article bears the legend "The pressures against controversy are felt everywhere". Here is a digest of what Oakes says. He begins by reporting an interview with a liberal Republican congressman who says "I am not sure that I'll run again. I'm tired of being called a Communist when I go back home. I don't like to see my wife or my child almost in tears the next day because somebody at the club or a kid in school or a friend of a friend has made a crack about how I must be a pinko or a pro-Communist."

There is little question, says Oakes, that in the future he will be more circumspect in his public utterances. Always in the back of his mind will be the unphrased thought that whatever he says about the real meaning of liberty and democracy may and probably will be used against him.

This is typical of what has happened to the attitude of tens of thousands of individuals in the professions, in academic life, in the arts and sciences, in private and public affairs, and of course in politics too. They

(continued on page 17)

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Back Copies. See the information on page 30.

Manuscripts. We desire to publish articles that are factual, useful, understandable, and interesting to many kinds of people engaged in one part or another of the field of computers and automation. In this audience are many people who have expert knowledge of some part of the field, but who are laymen in other parts of it. Consequently, a writer should seek to explain his subject, and show its context and significance. He should define unfamiliar terms, or use them in a way that makes their meaning unmistakable. He should identify unfamiliar persons with a few words. He should use examples, comparisons, analogies, etc., whenever they may help readers to understand a difficult point. He should give data supporting his argument and evidence for his assertions. An article may certainly be controsial if the subject is discussed reasonably. Ordinarily, the length should be 1000 to 4000 words, and payment will be $10 to $50 on acceptance. A suggestion for an article should be submitted to us before too much work is done. To be considered for any particular issue, the manuscript should be in our hands by the 5th of the preceding month.

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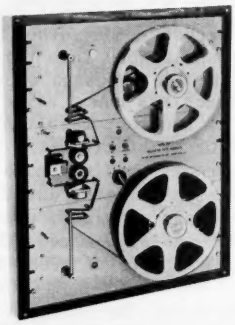

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High-speed magnetic-tape recorders having low start-stop times give a new dimension to data handling by absorbing digital information *when and where it is made* and making it available *when and where it is needed.*

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Potter Magnetic Tape Handlers offer, in addition to the new higher tape speeds mentioned, wider tape widths for more channels with lower tape tension controlled by photoelectric servos. And, the price is but a fraction of that of much less versatile recorders. Other data handling components and complete systems are also available for special problems.

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Processing Information Using A Common Machine Language: The American Management Association Conference, Feb. 1954

Neil Macdonald

Some big obstacles to the wide use of automatic machinery for handling information still exist. One conspicuous obstacle is price -- for many of the new machines cost a great deal. A second one is education --for the new equipment requires new kinds of people who know how to program, operate, and maintain it, and they are few in numbers and much in demand.

But one of the biggest of all the obstacles has been the lack of a common language among the information-handling machines of various types and made by various manufacturers. Until now, many of the machines have been unable to "talk" to each other without a human being to act as interpreter between them. In other words, information expressed in mechanical form for one machine was nearly always "incomprehensible" to another machine -- it could not take in the information in that form. For example, no machine, so far as I know, will take in recorded magnetic tape produced by one manufacturer and translate that information and record it in appropriate form on the magnetic tape of another manufacturer. One exception, in existence for some time, is reportedly that International Business Machines will rent you a machine that will convert Remington Rand punchcards into IBM punch cards, and that Remington Rand will rent you a machine that will convert IBM punch cards into Remington Rand punch cards; these are however one-use machines for changing over installations. But the general and accepted theory for some time has been that a consumer will choose and accept the machine language spoken by the machines of some one manufacturer, and thereafter always use just that language.

The precept of the isolation of machine languages, this linguistic iron curtain between machines, has been the point of major attack by the Methods Planning Division of the United States Steel Corporation, in their study during the last few years of the application of new information-handling machinery for their company.

Some of the results of their study were reported in New York, on February 25 and 26, at a Special Conference of the American Management Association. This conference, called "Integrating the Office for Electronics", was attended by over 1700 people, and included an exhibit of "common-language" machines from ten companies.

For, one of the main conclusions of the U.S. Steel group was that five-hole punched paper tape using the standard communication code should be the fundamental common machine language for their purposes. Any other machine language should be translatable into this, and from this any other machine language should be obtainable. Office machines now using this code (some machines as a direct result of U. S. Steel stimulation of manufacturers) include production recorders, adding machines, bookkeeping machines, typewriters, calculators, tape-to-punched-card machines, punched-card-to-tape machines, and high-speed data-processing equipment. Others of their conclusions were that:

- Original data should be recorded at its point of origin in a mechanical form;
- Once in mechanical form, the data should be processed exclusively in a mechanical way; and
- All the processing of data should be "integrated", so that the original data expressed in mechanical form should be sufficient for and usable in all later applications.

The name they have given to their plan is "Integrated Data Processing."

These conclusions and their ramifications were presented in the following talks given at the conference:

"Integrated Data Processing - Fundamentals", by H. F. Van Gorder, Director of Methods Planning Division, U.S. Steel Corporation.

"Panel Comment", by James M. Kalbach, Jr., Engineering Service Division, E. I. Du Pont de Nemours and Company; Harold Price, Price Waterhouse and Company; and John E. Walrath, Accounting Services Division, General Electric Co.

"Data Origination", by H. W. Moore, Methods Planning Div., USSC.

"Data Calculation and Distribution", by H. James Thomson, Methods Planning Div., USSC.

"Conversion and High-Speed Processing", by L. W. Calkins, Methods Planning Div., USSC.

"Accurate, Fast Communications", by R.W. Baridon, Methods Planning Div., USSC.

"Closed-Circuit Television Demonstration of the Machines in Action".

Abstracts of the talks were available in the conference program prepared by the American Management Association; and the talks themselves are to be printed in the magazine "Office Management."

The American Management Association stated "This conference is a demonstration to American business and industry of what one company

has done to get ready for office mechanization, and of some of the machines available. Completely new concepts of data processing will be required if business is to make the most efficient utilization of electronic knowledge. The A.M.A. has been watching the field of electronic equipment, looking for evidence that companies are beginning to adjust their office methods and procedure to the coming demands of electronic processes. ...

"The United States Steel Corporation was invited to describe its system of integrated data processing through common-language machines because it has taken positive action to get ready for electronization. The U.S. Steel program to be presented at the conference has applications for any company whose data processing involves repetitive operations, even if it has as few as 350 employees. H. F. van Gorder, Director, Methods Planning Division, U. S. Steel, and members of his staff have been working on common-language data processing for more than seven years. The system they devised was put into operation at U. S. Steel headquarters last spring and is in various affiliated companies. Eventually it will be installed throughout the U. S. Steel and subsidiary organization.

"This is the first time the philosophy and detailed operation of the U. S. Steel program has been described to a national audience. The basic concept is to make all data self-perpetuating and thus eliminate the necessity for copying. Data are recorded at the point of origin on a five-channel punched tape, and subsequent processing -- linking typewriters, calculators and electronic machines -- is automatic."

The "common language" machines exhibited at the conference were the following:

Addressograph Multigraph Corp.: Tape Perforator Class 7700
Automatic Graphotype Model 6700
The Bell Telephone System: No. 14 Typing Reperforator
No. 15 Page Keyboard Sending and Receiving Teletypwriter
No. 19 Page Automatic Sending and Receiving Teletypwriter
No. 28 Page Type Sending and Receiving Typewriter
Burroughs Corp.: Sensimatic Accounting Machine with Punched Paper Tape Output Tape Punch
Commercial Controls Corp.: Flexowriter
Computyper Corp.: Model C Computyper
Friden Calculating Machine Co., Inc.: Adding Machine with Tape Punch
International Business Machines Corp.: Type 854 Cardatype with Type 857 Auxiliary Typewriter
Type 46 Tape-to-Card Punch
Type 63 Card-to-Tape Punch
National Cash Register Co.: Class 2000 Window Posting Machine with Punched Paper Recorder
Class 21 Cash Register with Punched Paper Tape Recorder
Remington Rand, Inc.: Type 308-5 Tape-to-Card Converter
Type 318 Card-to-Tape Converter (90 column)
Western Union Telegraph Co.: Type 19 Sending and Receiving Teletype
Type 15 Sending and Receiving Teleprinter
Model 39A Typing Reperforator
Model 23A Typing Reperforator
Model 5031 Distributor-Transmitter

The uniform five-channel punched code is shown in the following table, where the numbers 543·21 correspond with holes ● ● ● · ● ● in the tape (the "·" representing the sprocket hole).

Code	Letters	Figures
21	A	-
541	B	-
432	C	-
41	D	-
1	E	3
431	F	-
542	G	-
53	H	-
32	I	8
421	J	-
4321	K	-
52	L	-
543	M	-
43	N	-
54	O	9
532	P	0
5321	Q	1
42	R	4
31	S	-
5	T	5
321	U	7
5432	V	-
521	W	2
5431	X	-
531	Y	6
51	Z	-
54321	Ltrs	
5421	Figs	
3	Space	
4	Car. Ret.	
2	L.F.	

Roster of Organizations in the Field of Computers and Automation

(Cumulative, information as of Mar. 10, 1954)

The purpose of this Roster is to report organizations (all that are known to us) making or developing computing machinery, or systems, or data-handling equipment, or equipment for automatic control and materials handling. In addition, some organizations making components may be included in some issues of the Roster. Each Roster entry when it becomes complete contains: name of the organization, its address, nature of its interest in the field, kinds of activity it engages in, main products in the field, approximate number of employees, year established, and a few comments and current news items. When we do not have complete information, we put down what we have.

We seek to make this Roster as useful and informative as possible, and plan to keep it up to date in each issue. We shall be grateful for any more information, or additions or corrections that any reader is able to send us.

Although we have tried to make the Roster complete and accurate, we assume no liability for any statements expressed or implied.

This listing is cumulative.

Abbreviations

The key to the abbreviations follows:

Size
- Ls Large size, over 500 employes
- Ms Medium size, 50 to 500 employees
- Ss Small size, under 50 employees (No. in parentheses is approx. no. of employees)

When Established
- Le Long established organization (1922 or earlier)
- Me Organization established a "medium" time ago (1923 to 1941)
- Se Organization established a short time ago (1942 or later) (No. in parentheses is year of establishment)

Interest in Computers and Automation
- Dc Digital computing machinery
- Ac Analog computing machinery
- Ic Incidental interests in computing machinery
- Sc Servomechanisms
- Cc Automatic control machinery
- Mc Automatic materials handling machinery

Activities
- Ma Manufacturing activity
- Sa Selling activity
- Ra Research and development
- Ca Consulting
- Ga Government activity
- Pa Problem-solving
- Ba Buying activity

(Used also in combinations, as in RMSa "research, manufacturing and selling activity")

*C This organization has kindly furnished us with information expressly for the purposes of the Roster and therefore our report is likely to be more complete and accurate than otherwise might be the case. (C for Checking)

*A This organization has placed an advertisement in this issue of COMPUTERS AND AUTOMATION. For more information, see their advertisement. (A for Advertisement)

ROSTER

Addressograph-Multigraph Corp., 1200 Babbitt Road, Cleveland 17, Ohio / Redwood 1-8000 /and elsewhere *C
Addressograph sensing plates, composed automatically from punched tape, which will automatically list and total figures. Data written at speeds up to 30 forty-character lines per second; as a byproduct, codes automatically punched into punch cards. Electronic facsimile printers for high-speed copying of typed data contained in unit card records. Ls(8000) Le(1898) Ic RMSa

Alden Electronic and Impulse Recording Equipment Co., Alden Research Center, Westboro, Mass. / Westboro 467 / *C
Facsimile recording equipment and facsimile components. Ma SEE Alden Products Co.

Alden Products Co., 117 No. Main St., Brockton, Mass. / Brockton 160 / *C
General and specific components for digital and analog computing machinery; plug-in components, sensing and indicating components, magnetic delay line units, magnetic storage cores, etc. Ms(300) Me(1930) Ic RMSa

Alfax Paper and Engineering Co., Alden Research Center, Westboro, Mass. / Brockton 160 / *C
Electrosensitive recording papers. Ma SEE Alden Products Co.

R. C. Allen Business Machines, Inc., 678 Front Ave., Grand Rapids 4, Mich. / Glendale 6-8541/ *C
Adding machines, bookkeeping machines, cash registers, etc. Ls(1250) Me(1932) DIc RMSa

American Automatic Typewriter Co., 614 North Carpenter St., Chicago 22, Ill. *C
Pneumatically controlled programming and testing devices. Automatic selective typing equipment (Autotypist). Testing machines

for typewriters, adding machines, calculating machines. Ms(100) Le(1868) Ic RMSa

Ampex Electric Corp., 934 Charter St., Redwood City, Calif. *C
Magnetic recording of data. Ms(350) Se (1944) Ic RMSa

ANelex Corporation, Concord, N. H., and 150 Causeway St., Boston 14, Mass. / Richmond 2-3400 / *C
High-speed printer (600 characters per second, numerical). Other input-output devices being developed. Ss Se DIc RMSa

Applied Science Corporation of Princeton, P.O.Box 44, Princeton, N. J. / Plainsboro 3-4141 / *C
Radio telemetering and automatic data conversion. Devices for automatic and semi-automatic reduction and analysis of telemetering and radar data. Analog read-in and read-out devices. Digital storage and computing elements. MADAM (Multipurpose Automatic Data Analysis Machine). Ms(85) Se(1946) DAc RCPMSa

Argonne National Laboratory, Chicago 18, Ill. *C
Maker of Oracle and Avidac automatic digital computers. Ls(3500) Me(1940) DIc RCGPa

Arma Corp., Old Country Rd., Garden City, L. I., N. Y. / Garden City 3-2000 / *C
Electronic fire-control apparatus. Analog computer components including resolvers, induction generators, etc. Basic weapon and control systems, navigational systems, precision remote control systems. Automatic machine tool and material handling systems. Analog computer components. Ls(6000) Le(1918) DASc RMSGPa

Armour Research Foundation, Illinois Inst. of Technology, 10 West 35 St., Chicago 16, Illinois / Calumet 5-9600 / *C
Magnetic recording. Digital, analog, and data-handling equipment. Automatic control machinery. Servomechanisms. Instrumentation. Ls(1200) Me(1936) DASCc RCPa

Askania Regulator Co., 240 E. Ontario St., Chicago, Ill. / Whitehall 4-3700 / *C
Use analog computers; manufacture servomechanisms and automatic controls. Ms(400) Me (1930) SCc RMSPa

Audio Instrument Co., Inc., 133 West 14 St., New York 11, N. Y. / Oregon 5-7820 / *C
Electronic, mechanical, and optical analog computers. Precision electronic instruments. Time-delay units. Fire control equipment, logarithmic amplifiers. Specialized passive computer which corrects for film nonlinearity in photometric work, etc. Ss(10) Se(1949) DACSc RCSa

Automatic Electric Co., 1033 West Van Buren St., Chicago, Ill. / Haymarket 1-4300 / *C
Automatic electrical systems, telephone equipment, relays, stepping switches, etc., for computing machinery companies and independent telephone companies. Automatic control components. Ls(6000) Le(1892) ICc RMSa

The Austin Co., Special Devices Div., 76 9th Ave., New York 11, N. Y. / Watkins 4-3630 / *C
Systems and devices for automatic control in commerce and industry: analog, digital, data-handling, servo, electronic, electromechanical. Shaft position indicators and systems; cathode ray indicators and systems. Ls(division, 125; company, 25,000) Le(division, 1943; company, 1878) DASCMc RMSa

Automatic Signal Division, Eastern Industries, Inc., Norwalk, Conn.
Automatic volume-density traffic controllers. Me Ic RMSa

Automation Consultants, Inc., 1450 Broadway, New York 18, N. Y. / Chickering 4-8000 / *C
Consultants in electronic systems and devices, including automatic information-handling. Ss Se(1953) DSCc CPBa

Avion Instrument Corp., Div. American Car & Foundry Co., Paramus, N. J. / Oradell 8-4100 / *C
Digital and analog computing machinery. Magnetic recorders, amplifiers, electronic choppers, test equipment, servomechanisms, automatic control machinery, etc. Ms(130) Se(1946) RMSGa DAIc

Baird Associates, 33 University Road, Cambridge, 38, Mass. / University 4-0101 / *C
Spectroscopic analysis equipment. Scientific instruments. Analog devices and servomechanisms. Instrumentation for industrial control. Research in physical optics. Ms (170) Me(1936) AISc RMSa

Barber-Colman Co., Rockford, Ill. *C
Automatic controls, textile machinery, machine tools, etc. Barber-Colman-Stibitz digital computer, operating. Ls(3000) Le Dc RMSa

Beckman Instruments Inc., South Pasadena, Calif. *C
"Analog-digital" converter. Special purpose control computers. EASE computer (Electronic Analog Simulating Equipment). Ls(1000) Me(1934) DAc RMSa ALSO SEE Berkeley Division, Beckman Instruments

Bell Telephone Laboratories, Murray Hill, N. J. / Summit 6-6000 / and 463 West St., New York, N. Y. / Chelsea 3-1000 / *C
Automatic switching. Bell general purpose computers (relay and electronic, digital and analog) for government use and company's own use. Ls Le DAc RGPa

Bendix Aviation Corporation, Computer Division, 5630 Arbor Vitae St., Los Angeles 45, Calif. *C
Electronic information-processing machines. Electronic computers; data-processing equipment; automatic control systems; Decimal Digital Differential Analyzer. Ms(30) Se (1952) DACc RMSPa

Bendix Aviation Corp., Pacific Division, North Hollywood, Calif. *C
Telemetering systems. Digital systems, controls, and components. Ls(2500) Le(1915, company; 1937, this division) Ic RMSa

Benson-Lehner Corp., 2340 Sawtelle Blvd., West Los Angeles 64, Calif. *C
Automatic and semi-automatic devices (both analog and digital) for computing, data analyzing, data reduction, optical measuring, guided missile analysis, etc. Commercial applications of industrial control devices. Ms(65) Se(1950) DAc RCMSa

Berkeley Division, Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif. / Landscape 6-7730 /
EASE computer (Electronic Analog Simulating Equipment) for solving equations, simulating systems, etc. Se Ac RMSa

Edmund C. Berkeley and Associates, 36 West 11 St., New York 11, N. Y / Algonquin 4-7675 / and

815 Washington St., Newtonville 60, Mass. / Decatur 2-5453 or 2-3928 / *C
Logical design, applications, marketing, etc., of automatic information-handling machinery. Publisher of "Computers and Automation". Small one-of-a-kind computers (Simon) and robots (Squee); more under construction. Courses, publications. Ss(8) Se(1948) Dc RCMSa

Birkbeck College, University of London, London, England. *C
Maker of ARC, APEXC, and SEC digital computers; electronic digital computers. Ss(10 to 20) Se(1946) Dc RCPa

Boeing Airplane Co., Seattle 14, Wash.
BEAC, Boeing Electronic Analog Computer. Servomechanisms and analog computing devices. Ls Le ASc RMSa

British Tabulating Machine Co., Ltd., 17 Park Lane, London W.1, England. *C
Punched card machines. Ls(4500) Le(1908) Dc RCPMSa

Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio (formerly Brush Development Co.) *C
Recording analyzers. Magnetic tape, heads, and drums. Computer components. Ls(1300) Le(1921) Ic RMSa

Bull S. A. Compagnie des Machines, 94 Avenue Gambetta, Paris, France.
Punch card machines. Development of electronic computer components. Ls(3000) Le Dc RMSa

Bureau of the Census, Washington 25, D. C. *C
Tabulation of statistical data by special machines designed and built for own use, by commercial punch-card equipment, and by electronic computing system (the Univac). Ls (1100 in Machine Tabulating Division) Le(1890 in punch card field) Dc Ga

Burroughs Corporation (formerly Burroughs Adding Machine Co.), 6071 Second Ave., Detroit, Mich./ Triangle 5-2260 / -- headquarters; Research Division -- 511 No. Broad St., Philadelphia, Pa./ Walnut 2-3973 / and elsewhere. *C
Adding machines, bookkeeping machines, etc. Research division has made Burroughs Laboratory computer, an electronic digital test computer, assembled from pulse control units. Fast-access magnetic-core memory. Pulse control components, servomechanisms. This company owns Control Instrument Co. Ls(18,000) Le(1896) DSc RMSPa

Clary Multiplier Corp., 408 Junipero St., San Gabriel, Calif. *C
Adding and calculating machines, cash registers, electronic counters, analog-digital converters, input and output equipment for computers, data-reduction systems. Ls(1500) Me(1939) DAc RMSa

Commercial Controls Corp., 1 Leighton Ave., Rochester 2, N. Y. / Culver 5300 /
Mailroom equipment. "Flexowriter" electric typewriter with punched paper tape control. Ls Le Ic RMSa

Commonwealth Scientific and Industrial Organization, Radiophysics Division, Sydney, New South Wales, Australia
Maker of CSIRO Mark I electronic digital computer of Inst. for Advanced Study type. DAc RCGPa

Computation Centre, Univ. of Toronto, Toronto, Canada. *C
Digital, electronic computers. Now operating: a Ferranti Electric automatic computer; IBM installation. Ss(15) Se(1947) RPa Dc

Computer Control Co., 106 Concord Ave., Belmont, Mass. / Belmont 5-6161 / and 1429 Promenade Hwy., Santa Monica, Calif. / *C
Computers and computer components, digital data-handling systems, solid delay line acoustic memory, computer test equipment, dual beam conversion kits, specialized systems and instrumentation. Operating and servicing Raydac at Pt. Mugu. Ss(22) Se(1952) Dc RMSa

Computer Corp. of America, 149 Church St., New York 7, N. Y. / Barclay 7-7618 /
Electronic analog computer. Se Ac RMa

Computer Research Corp. of California, subsidiary of National Cash Register Company, 3348 West El Segundo Blvd., Hawthorne, Calif. *C
Digital computers, data processing machines, decimal digital differential analyzers, computer components, magnetic components. Computing systems (general and special purpose, business or scientific). CRC102-A general purpose computer and other computers. Ms (350) Se(1950) Dc RCMSa

Computing Devices of Canada, Lim., P. O. Box 503, Ottawa, Ont., Canada / Ottawa 5-4387 / *C
Digital and analog computers, automatic navigation systems, electronic laboratory test equipment, simulators, servomechanisms. Research and development in instrumentation, automatic control, business sorting, scientific sorting, systems analysis. Ms(120) Se (1948) DASCc RCPMSGa

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif / Sycamore 6-0173/ *C
Automatic electronic digital computers (Model 30-201). Digital and analog data-handling and conversion systems (Sadic, Millisadic, etc.). Automatic translator magnetic tape to punched card. Ls(900) Me(1937) Dc RMSa

Consolidated Vultee Aircraft Corporation, San Diego 12, Calif. *C
Output devices for telemetering and computing systems. The Charactron, equipment including a cathode-ray tube that at high speed converts analog or coded information into alphabetic or numeric light images on the screen. Ss(20 on this project) Se(1951 on this project) Ic RMSa

Control Instrument Co., 67 35th St., Brooklyn, N. Y. / Sterling 8-0658 / *C
Fire-control equipment. 1000-line-a-minute tabulator. Digital and analog machines and components. Now a subsidiary of Burroughs Corporation. Ls(1200) Me(1934) DAc RMSa

Cook Research Laboratories, division of Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill. (mail address), 8100 Monticello Avenue, Skokie, Ill. (location) / Keystone 9-2060 /
Magnetic data-recording systems; digital, analog, and hybrid information-processing systems; digital recording systems -- particularly for aircraft and airborne applications. Basic and industrial research in servomechanisms, air research, weather reconnaissance, guided missiles, etc. Ms(320) DAIc RCa

Curta Calculator Co., 3851 West Madison St., Chicago 24, Ill.
Eight-ounce, hand-powered, rotary "brief-case" calculator; adds, subtracts, multiplies, divides; totals to 15 decimal places; made in

Lichtenstein. Ss(10) Se(1952) Dc Sa

Daco Machine Co., Brooklyn, N. Y. / Ulster 5-8350/
Computing controls for machine tools. Cc RMSa

Davies Laboratories, Inc., 4705 Queensbury Road, Riverdale, Md. *C
ANSER, analog simulator and computer. Automatic data-reduction equipment. Magnetic tape recorders. Ms(85) Se(1946) Ac RMSCa

The de Florez Co., 116 East 30 St., New York, N.Y./ Murray Hill 6-5730 /
Magazine subscription fulfillment problem, etc. Ss Se DAc RCa

Digital Control Systems, Inc., Top of Mount Soledad, P. O. Box 779, La Jolla, Calif. / Glencove 5-6109 / *C
Design and construction of laboratory models of many types of digital computers and control systems. Ss Se(1951) DCc RMSa

Digital Products Inc., 7952 Ivanhoe Ave., La Jolla, Calif. *C
Digital computers, etched circuitry, magnetic heads, memory drums. Ss Se(1952) DIc RMSa

Eckert-Mauchly Division, Remington Rand, Inc., 3747 Ridge Ave., Philadelphia, Pa., and elsewhere *C
All purpose electronic digital computers. Univac Factronic System. Ls(600)? Se(1946) Dc RCMSa ALSO SEE Remington Rand, Inc.

Thomas A. Edison, Inc., Instrument Division, 22 Lakeside Ave., West Orange, N. J. / Orange 3-6800 / *C
Automatic control components, time delay relays. Ms(360 in division; 4000 in company) Le(1888) Ic RMSa

Electronic Associates, Inc., Long Branch, N. J. / Long Branch 6-1100 / *C
General purpose precision analog computers, special purpose analog computers, analog computer components, digital-to-analog converter, digital plotting system (Dataplotter). Automatic control of all machine tools. Ms(360) Se(1945) DACc RMSa

Electronic Computer Div. of Underwood Corp., 35-10 36th Ave., Long Island City 6, N. Y. / Exeter 2-3400 / *C
Constructing five types of electronic digital computers (ELECOM-100, -120, -125, 2200, and a data-handling computer). Delay lines, decade delay lines, pulse transformers, magnetic recording heads, magnetic drums, D.C. plug-in amplifiers. Ms(200) Se(1949) Dc RMSa

Electronic Engineering Co., 180 South Alvarado St., Los Angeles 57, Calif. / Dunkirk 2-7353 /
Analog computing machinery. Analog-to-digital-to-analog converters. Polar-to-rectangular-to-polar converters. Servomechanisms. Ms Se DAc RMSa

Elliott Addressing Machine Co., 143 Albany Street, Cambridge 39, Mass. / Trowbridge 6-2020/
Addressing stencils, with selection controlled by punched holes in cardboard margin. Ls Le Ic RMSa

Elliott Bros. (London) Ltd., Century-Works, Lewisham, London, S.E. 13, England, and Computer Division at Research Laboratories, Elstree Way, Borehamwood, Herts., England. *C
Digital and analog computers; servomechanisms. Ls(3000) Le(1800) DASc RMSa

Engineering Research Associates, Div. of Remington Rand, Inc., 1907 Minnehaha Ave., St. Paul, Minn., and 510 18th St. South, Arlington, Va. *C
Digital computers; ERA 1101 and 1103 electronic digital computers; the Logistics Computer. Magnetic storage systems, including magnetic heads, magnetic drums, etc. Shaft-position indicator systems, self-recording accelerometers, analog magnetic recording systems, data-handling equipment, special purpose communications equipment, pulse transformers, Ls(750) Se(1946) Dc RMCPSa ALSO SEE Remington Rand, Inc.

Engineers Northwest, 100 Metropolitan Life Bldg., Minneapolis 1, Minn. *C
Test-scoring machines and equipment. Ss(20) Se(1945) DAc RCMa

English Electric Co., Stafford, England. *C
Manufacturers of fully engineered versions of ACE (see National Physical Laboratory). Ls Le DIc RMSa

E-Z Sort Systems, Ltd., 45 Second St., San Francisco 5, Calif.
Edge-punched cards for filing and sorting data. Ms(250) Me(1935) Ic RCMa

Fabrica Addizionatrice Italiana S. S., Viale Umbria 36, Milan, Italy.
Desk calculators to add, subtract, multiply, divide, print. Dc RMSa

Facit, Inc., 500 5th Ave., New York 36, N. Y. (subsidiary), Stockholm, Sweden (headquarters), and elsewhere. *C
Calculators, adding machines, typewriters, etc. (in 1390 A.D., copper mining). Ls (4000) Le(1390 A.D.) Dc RMSa

Fairbanks Associates, 248 Greenwich Ave., Greenwich, Conn. / Greenwich 8-7155 / *C
Consultants in application and installation of electronic systems in clerical methods and procedures; evaluation of proposed savings; operations research. Ss(7) Se(1952) DIc RCPa

Federal Telephone and Radio Co., 100 Kingsley Rd., Clifton, N. J. / Nutley 2-3600 / *A
A division of IT&T. Vacuum tubes, selenium rectifiers, germanium diodes, contact protectors, coaxial cables, radio and telephone systems, and associated components. Ls(7000) Me(1941) ISCc RMSPa

Felt and Tarrant Mfg. Co., Comptometer Div., 1735 North Paulina St., Chicago 22, Ill. / Brunswick 8-5000 / *C
Adding-calculating machines, key-driven, electric and non-electric. Comptometer. Ls (1700) Le(1886) Dc RMSa

Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y. / Circle 7-0911 / agent for Ferranti Electric Ltd., Moston, England, and Mount Dennis, Toronto, Canada. *C
Complete electronic digital computers (Ferranti; also called "Manchester Universal Electronic Computer"). High-speed photoelectric tape reader, which can read up to 200 characters per second. Magnetic drum and electrostatic storage components, etc. Ls(10,000) Le(1896) Dc RMSa

Ferroxcube Corporation of America, 377 East Bridge St., Saugerties, N. Y. / Saugerties 1000 / *A
Ferrite core materials, including pot cores, cup cores, recording heads, and microminiature toroids with square hysteresis loop. Magnadur permanent magnet materials. Ms (100) Se Ic RMSa

Ford Instrument Co., Div. of The Sperry Corporation, 31-10 Thomson Ave., Long Island City 1,

N. Y. / Stillwell 4-9000 / *C
Gun fire control apparatus. Analog computers and components, magnetic amplifiers, servo motors, differential and integrator elements. Instruments for shipborne and airborne armament and navigational control. Ls(3800) Le(1915) ASc RMPCSa

The Franklin Institute Laboratories for Research and Development, 20th St. & Benjamin Franklin Parkway, Philadelphia 3, Pa. / Locust 4-3600/*C
Fire-control equipment. Special purpose analog computers, large and small scale. Digital computer components. Prototype construction. Ms(325) Se(1946) DAc Ra

Friden Calculating Machine Co. Inc., San Leandro, Calif. *C
Desk calculating machines. Computyper. Ls (2000) Me(1934) Dc RMSa

General Controls, 801 Allen Ave., Glendale 1, Calif. *C
Automatic controls (pressure, temperature, level, flow). Ls Cc RMSa

General Electric Co., Syracuse, N. Y., and Schenectady, N. Y. *C
Digital and analog, electric and electronic, computers and analyzers. Network analyzers. Automatic electronic digital computers, OARAC. Ls(c.220,000) Le Ic RMSa

Gerber Scientific Instrument Co., 89 Spruce St., Hartford 1, Conn. *C
Graphical computer "Graphanalogue". Ss Se (1946) Ac RMSa

Goodyear Aircraft Corp., Dept. 65A, Akron 15, O. *C
Goodyear electronic differential analyzers. (GEDA line of analog computing equipment). Ls Me Ac RMSa

Haller, Raymond, and Brown, Inc., State College, Pa. *C
Electronic digital computer for solution of up to 1200 simultaneous equations, using magnetic drum and tape. Research and development on computer components, analog computers, electronic and electromechanical systems. Engineering alanysis, operations research, electronic development. Ms(150) Se(1947) DAc RMSa

Hamann Calculating Machine Co., 2118 Land Title Bldg., Philadelphia 10, Pa.
Adding, subtracting, multiplying desk calculators. Dc MSa

Harvard Computation Laboratory, Cambridge 38, Mass. *C
Harvard Mark I, II, III, IV calculators for Navy, Air Force, and own use. Ms Se Dc RPMa

Hillyer Instrument Co., 54 Lafayette St., New York 13, N. Y. / Digby 9-4485 / *C
Simulators, servomechanisms, sensing, computing, and actuating systems. Automatic machine controls. Ms(100) Se(1945) DAICs RMSa

Hogan Laboratories, 155 Perry St., New York 14, N. Y. / Chelsea 2-7855 /
Circle computer, completed and under test; manufactured by this company. Digital high-speed printers. Associated with Nuclear Development Associates. Ms(60) Me(1929) Dc RMSa

Hughes Research and Development Laboratories, Hughes Aircraft Co., Culver City, Calif. *A
Automatic data-handling systems. Industrial process control systems. Small, powerful, automatic electronic digital computer for airborne use. Fire-control equipment. Aircraft control. Navigation systems. Ls Me DAc RMSa

Institut Blaise Pascal, Laboratoire de Calcul Analogique, 155, rue de Sèvres, Paris 15, France Ac PPa

Institut Blaise Pascal, Laboratoire de Calcul Mécanique, 25, Avenue de la Division Le Clerc, Chatillon-sous-Bagneux (Seine), France *C
Constructing a digital calculator. Ss(9) Me(1939) Dc RPa

Institute for Advanced Study, Princeton, N. J.
"Maniac", big fast electronic digital calculator, for own use. Dc RPMa

Intelligent Machines Research Corp., 134 South Wayne St., Arlington, Va. / Jackson 5-7226 / *C, *A
Devices for reading characters on paper, etc. Pattern interpretation equipment. Sensing mechanisms. Digital computer elements. Ss (10) Se(1951) Dc RCMSa

International Business Machines Corp., 590 Madison Ave., New York 22, N. Y. / Plaza 3-1900 / and elsewhere *C
Punch card machines. Type 650, Magnetic Drum Calculator. IBM electronic Data Processing Machines, Type 701 (magnetic tape, magnetic drum, electrostatic storage). Card Programmed Calculator. Electronic calculating punch Type 604. Data processing equipment. Process control equipment. Automatic Source Recording Equipment. Ls(42,000) Le(1911) Dc RMSa

International Telemeter Corp., 2000 Stoner Ave., Los Angeles 25, Calif. *C
Systems and devices for clerical and control applications. High-capacity rapid-access ferrite core memories. High-density photographic information storage. Metered and piped television. Ms(100) Se(1951) RMSa

International Telephone and Telegraph Corp., 67 Broad St., New York, N. Y. / Bowling Green 9-3800 /
Equipment for airline reservation problem. Fully automatic pneumatic tube system, by dialing. Ic RMSa

Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda 14, Md. *C
High-speed small, compact digital computers (Jaincomp A, B, B1, B2, C). Pulse transformers, delay lines, magnetic storage systems. Input and output devices. Complete instrument systems. Ss(30?) Se(1948) DASCc RMSa

Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena 3, Calif. *C
Analog, digital, and data-handling systems. Research and development in jet propulsion and missile guidance. Ls(1000; about 50 on computers) Me(1942) DAc RCPa

Ketay Manufacturing Co., 555 Broadway, New York 12, N. Y., and elsewhere / Digby 9-2717 /
Automatic control systems; synchros, servo motors, resolvers; magnetic, electronic, and resolver amplifiers. Electronic equipment. Servomechanisms. Ls(2000) Se(1943) CISc RMSa

A. Kimball Co., 307 West Broadway, New York 13, N. Y. / Canal 6-2300 / *C

Machine for printing and punching garment tags. Input mechanisms. Ms(200) Le(1876) Ic RMSPa

Laboratory for Electronics, 75 Pitts St., Boston 14, Mass. / Richmond 2-3200 / *C
Analog and digital computers, special computers to suit customer requirements, delay lines (mercury, quartz), plug-in packages for computer applications, etc. Ls(700) Se (1946) DAc RMSa

Lanston Monotype Machine Co., Barrett Adding Machine Div., 24th & locust Sts., Phila. 3, Pa. / Locust 7-4614 /
Adding, subtracting, and printing, desk calculators. Dc RMSa

Leeds and Northrup, 4901 Stenton Ave., Philadelphia 44, Pa. / Michigan 4-4900 / *C
Automatic recorders and controls. Ls(3150) Le(1899) Cc RMSa

Librascope, Inc., 1607 Flower St., Glendale, Calif. *C
Mechanical and electrical analog computers; primarily special-purpose. All phases of data-handling. Ls(600; about 30 on computers) Me(1937) DASc RMSa

Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass. / University 4-9370 / *C
Analog digital converter, "Automatic Digital Recorder of Analog Data" (ADRAD). Conversion and input devices. Ls(700) Le(1886) Ic RCa

Logabax Co., 12 rue de l'Arcade, Paris, France
Collaborating with Institut Blaise Pascal on computing devides. DIc RMSa

Logistics Research, Inc., 141 So. Pacific Avenue, Redondo Beach, Calif. *C
Digital computers and computing systems (ALWAC). Data-reduction and data-handling systems, input and output equipment, automatic graph-plotters, large scale magnetic memories with "air-floated" magnetic heads, etc. Ss(35) Se(1952) DIc RMSa

W. S. Macdonald Co., Inc., 33 University Road, Cambridge, Mass. / Trowbridge 6-8130 / *C
Digital business machines using magnetic drum memory for 10,000 registers; etc. Ss (20) Se(1946) Dc RMSa

Marchant Calculators, Inc. (formerly Marchant Calculating Machine Co.), Oakland 8, Calif. *C
Desk calculators. Marchant-Raytheon Binary-Octal desk calculator. Ls(1500) Le(1913) Dc RMSa

Marchant Research, Inc., Oakland 8, Calif. (formerly Physical Research Laboratory, Pasadena, Calif.) (subsidiary of Marchant Calculators, Inc.) *C
Electronic digital computers (including Miniac). Magnetic storage systems, magnetic heads, data-handling equipment including analog-to-digital converter, computer components. Ss Se Dc RMSa

Massachusetts Institute of Technology, Digital Computer Laboratory, 211 Mass. Ave. / Eliot 4-3311 /; also Center of Analysis; Cambridge 39, Mass.
"Whirlwind" electronic digital computer. Ms(300+) Se(1945?) DAc RCPa

Mathematisch Centrum, 2e Boerhaavesstraat 49, Amsterdam, Netherlands. *C
Relay computer in use; electronic computer under construction. Ms(60) Se(1946) Dc RCPa

The W. L. Maxson Corp., 460 West 34 St., New York 1, N. Y. / Longacre 5-1900 / and elsewhere
Servomechanisms, analog computers, and digital computers for fire control, navigation, etc. Automatic control machinery. Ls(3000) Me(1935) DASCc RMSa

Mechanical Handling Systems, Inc., 4600 Nancy Ave., Detroit 12, Mich.
Automatic conveyors for moving separate articles, large or small, heavy or light, etc., in manufacturing processes. Ls Me Mc RMSa

Mellon Institute of Industrial Research, Multiple Fellowship on Computer Components, University of Pittsburgh, Pittsburgh 13, Pa. *C
Ss(6) Se(1950) Dc RCa

Mid-Century Instrumatic Corp., 611 Broadway, New York 12, N. Y. / Spring 7-4016 /
Components for electronic analog computers: function-generators, multipliers, etc. Ss (20) Se(1947) Ac RMSa

Minneapolis-Honeywell Regulator Co., Industrial Division, 4580 Wayne Ave., Philadelphia 44, Pa./ Michigan 4-8300 / *C
Automatic controllers. Brown Instruments. Servo components used in computers. Recording and indicating instruments and control equipment, etc. Ls(3500) Le(1859) Cc RMSa

Minnesota Electronics Corp., 47 West Water Street, St. Paul 1, Minn. *C
Digital and analog computers. Magnetic components, magnetic decision elements. Data reduction systems, telemetering. Ss(35) Se (1946) DAIc RMSa

Monrobot Corp., Morris Plains, N. J. / Morristown 4-7200 / *C, *A
Monrobot automatic electronic digital computers. Subsidiary of Monroe Calculating Machine Co. Ss(32) Se(1952) Dc RMSa

Monroe Calculating Machine Co., Orange, N. J. / Orange 3-6600 / and elsewhere. *C
Desk calculating machinery for adding, calculating, and bookkeeping. SEE Monrobot Corp. Ls(4000) Me(1925) Dc RMSa

Moore School of Electrical Engineering, Univ. of Pennsylvania, Philadelphia, Pa. *C
Place where Eniac and Edvac electronic digital computers were constructed. Constructing MSAC (Moore School Automatic Computer). Analog and digital equipment. Ms(80) Me (1923) DAc RCPMa

Mountain Systems, Inc., 94 Lake St., White Plains, N. Y. / White Plains 9-0714 /
Data processing systems and digital computer systems. Ss Se Dc RMSCa

National Bureau of Standards, Division of the National Applied Mathematics Laboratories: *C
(1) Computation Laboratory, Washington 25, D. C. SEAC, Bureau of Standards Eastern Automatic Computer. Ms(100) Me(1938) Dc RCPGa
(2) Institute for Numerical Analysis, 405 Hilgard Ave., Los Angeles 24, Calif. SWAC, Bureau of Standards Western Automatic Computer. Ms(100) Se(1947) Dc RCGa
(3) Machine Development Laboratory, Washington 25, D. C. Specifications development. Systems analysis. Ss(10) Se(1947) Dc RCGa

National Bureau of Standards, Electronics Division, Electronic Computers Laboratory, Washington 25, D. C. *C
Digital computers, data processing systems,

input-output devices. Storage elements, transistors, diodes, delay lines, etc. Have designed and assembled Seac and Dyseac electronic digital computers, etc. Ms(110) Se (1946) Dc RCMBGa

National Cash Register Co., Main and K Sts., Dayton, Ohio, and elsewhere. *C
Cash registers. Accounting-bookkeeping machines. Adding machines. Purchaser of Computer Research Corporation. Ls(33,000) Le(1884) Ic RMSa

National Physical Laboratory, Electronics Section, Teddington, Middlesex, England. *C
Digital computers and associated equipment. Designer and builder of the Pilot Model of ACE (Automatic Computing Engine -- high speed, electronic, digital). Collaborates with English Electric Co. Ls(1000; Elecnc Sec., 25) Le(1800; Elecnc Sec., 1948) DIc RCPMa

Northrop Aircraft Co., Hawthorne, Calif.
Computing center; develops, maintains, operates own computing equipment. Data reduction and analysis. Development of computing systems on order. Ms(70 this project) Se(1950 this project) DAc RCPa

Notifier Manufacturing Co., 239 South 11 Street, Lincoln 8, Nebraska / Lincoln 5-2946 / *C
Automatic control machinery for fire alarms. Automatic control circuits, computer circuits, switching circuits. Ss(40) Se(1949) CIc RMSCa

Nuclear Development Associates, 80 Grand St., White Plains, N. Y. / White Plains 8-5800 / *A
Circle Computer, completed and under test; designed by this company. Associated with Hogan Laboratories. Ss Se DIc RMSa

Olivetti Corp. of America, 580 Fifth Ave., New York 36, N. Y. / Judson 2-0637 / and associated companies elsewhere. *C
Desk adding, calculating, and printing machines. Fully automatic printing calculators. Ls(6000) Le(1908) Dc RMSa

Panellit, Inc., 6312 North Broadway, Chicago 40, Ill. / Rogers Park 1-1300 /
Equipment for automatic control: coordinated and graphic control panels for process variables; multiple-point scanning systems; annunciator systems. Cc RMSa

Pennsylvania State College, X-Ray and Solid State Lab., Dept. of Physics, State College, Pa. *C
X-RAC computer for crystal electron density functions. S-FAC for structure factor interpretations. Ms(55) Se(1947) Ac RPa

George A. Philbrick Researches, Inc., 230 Congress St., Boston 10, Mass. / Liberty 2-5464 / *C
Philbrick electronic analog computing equipment and components. Ss(5) Se(1946) Ac RCMSa

Photon, Inc., 58 Charles St., Cambridge 38, Mass./ Trowbridge 6-1177 / *C
Machinery for composing type by photographs. First photographically-composed book has been published. Ms(100) Me(1940) DIc RCMSa

Pitney-Bowes, Inc., Stamford, Conn. *C
Postage meters. Tax-stamping meters. "Tickometer" counting and/or imprinting machines. Ls(3000) Le(1920) Ic MSa

Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y. / Great Neck 2-0532 / *C, *A
Electronic counters. Magnetic tape handler; digital printer; electronic tag reader. Random access memory. High speed printer ("flying typewriter"). Analog-to-digital converter. Ms(100) Se(1942) Dc RMSa

Powers-Samas Accounting Machines, Ltd., England.
Punch card tabulating equipment using small, medium, and standard cards. Agency is Underwood Corp., which SEE. Ls(6000) Le(1916) DIc RMSa

Productions Electroniques, 8, rue Laugier, Paris 17, France
Collaborating with Institut Blaise Pascal on magnetic recording devices. Ic RMSa

Radio Corp. of America, RCA Laboratories Division, Princeton, N. J.; RCA Victor Division, Camden, N. J. *C
Selective electrostatic storage tube (formerly Selectron), Radechon, Graphecon, Williams Tube, Time Interval Counter. Computer systems. Magnetic matrix memory. Ls Le Ic RMSa

The Rand Corporation, 1700 Main St., Santa Monica, Calif. *C
Constructing an electronic digital computer of the type of the Institute for Advanced Study. Ls(500) Se(1946) DAIc RCPa

Raytheon Manufacturing Co., Waltham, Mass. / Waltham 5-5860 / *C, *A
Electronic digital computer systems for scientific applications (RAYDAC), and for general accounting and data-handling applications. Tape-handling mechanisms, magnetic heads, magnetic shift registers, and other computer components and subsystems. Computing service to analyze problems in applied mathematics, in engineering, and in industrial logistics by digital computer. Radar, fire control, microwave equipment, etc. Ls (20,000) Me(1925) DAc RMSa

Reeves Instrument Co., 215 East 91 St., New York 28, N. Y. / Trafalgar 6-6000 /
Fire-control equipment. "REAC" electronic analog computers. Ls Me Ac RMSa

Remington Rand, Inc., 315 4th Ave., New York 10, N. Y. / Spring 7-8000 / *C, *A
Punched card machines, office machines, electronic digital computing systems (Univac Factronic System, ERA 1101, ERA 1103), servomechanisms. SEE also Eckert-Mauchly Division and Engineering Research Associates Division. Ls(30,000; 1800 on computers) Le DASc RCMSa

Robotyper Corporation, 125 Allen St., Hendersonville, N. C. / Hendersonville 4246 /
Automatic typing equipment that can be associated with any electric typewriter, using a record roll pneumatically operated. Ic RMSa

Scientific Computing Service, Ltd., 23 Bedford Sq., London, W. C. 1, England. *C
Ss(16) Me(1938) DAIc CPa

Servo Corporation of America, New Hyde Park, N. Y. / Fieldstone 7-2810 / *C
Servomechanisms. Automatic controls. Analysis and synthesis for controls manufacturers. Temperature controls by infra-red radiation. Industrial controls. Servo components and test equipment. Analog and digital computers. Ms(230) Se(1946) DASCc RMSa

Servomechanisms, Inc., Post and Stewart Avenues, Westbury, L.I., N. Y. / Westbury 7-2700 / and elsewhere. *C
Automatic, electronic, and electro-mechanical control systems, instrumentation, and components. Analog computers. Ls(700) Se (1946) ASCc RMSa

Société d'Electronique et d'Automatisme, 138 Blvd de Verdun, Courbevoie, Seine, France. *C
Analog and digital computers. Servomechanisms, electronic equipment for machine tools. Ms(300) Se(1948) DASc RMSa

Soroban Engineering, Inc., Box 117, Melbourne, Fla.
Electronic digital computers and accessories. Automatic keyboard device with 21 keys for input to an automatic electronic digital computer. Ss Se(1953) Dc RMSa

Sperry Gyroscope Co., Great Neck, N. Y. / Fieldstone 7-3600 / *C
Ordnance; fire-control equipment. Automatic controls. Navigation equipment, sea and air. Radar, Loran, gyrocompasses, precision instruments. Ls(18,000) Le(1910) Ac RMSa

Sprague Electric Co., 377 Marshall Street, North Adams, Mass. *A
Capacitors: miniature, and low dielectric hysteresis loss, for computer applications. Standard capacitors; precision and power type resistors; pulse transformers; radio interference filters. Ls ?e Ic RMSa

Swedish Board for Computing Machines, Drottninggatan 95A, Stockholm, Sweden. *C
Planned the relay computer BARK (Binary Automatic Relay "K"omputer) which was then built by the Royal Telegraph Administration. BARK has run commercially since July 1950. Planning and constructing an electronic computer of the Princeton type. Ss(30) Se(1949) Dc RMCPa

Sylvania Electric Co., Radio and Television Div., 70 Forsyth St., Boston 15, Mass. / Kenmore 6-8900 / and elsewhere *C
Electronic digital computers using printed circuit techniques. Subassemblies of diodes and triodes. Computer components. Ls(2200; this division 190) Le(1901; this division 1945) DAc RMSa

Taller and Cooper, 75 Front St., Brooklyn, N. Y./ Main 4-8550 *C
Data recording and conversion systems printers, perforators, analog to digital converters. Function generators, computers. Toll equipment for bridges, highways, turnpikes. Ms(250) Me(1926) DIc RMSa

Tally Register Corp., 5300 14th Avenue, N. W., Seattle 7, Wash. *C
Special-purpose business machines and instruments. High speed data-reduction system for telemetering applications; electrosensitive tape recorders and readers; tape-to-card converters; binary-decimal converters; data input devices. Ss Se DICMc RMSCa

Taylor Instrument Co., Rochester, N. Y.
Automatic controllers. Ls Le Cc RMSa

Technitrol Engineering Co., 2751 North 4 Street, Philadelphia 33, Pa. / Ga 3-2937 / *C
Computing and control equipment. Complete digital systems. Components, pulse transformers. Electrical and acoustic delay lines. High speed memories. Time serial computers. Ms(75) Se(1947) DAc RMSa

Telecomputing Corp., 133 E. Santa Anita Avenue, Burbank, Calif. / Charleston 0-8161 / *C
Automatic data reading, recording, and plotting equipment (Universal Telereader, Telecordex, Teleducer, Contact Telereader, Teleplotter). Ms(250) Se(1947) DCMc RMSPa

Teleregister Corp., 157 Chambers St., New York 7, N. Y. / Digby 9-4440 / *C
Digital and analog special purpose computers. Data inventory systems for special applications -- travel reservations, flight data processing, stock market quotations, etc. Magnetronic Reservoir, in use at American Airlines' reservations center. Magnetronic stock quotation system now in use at Toronto Stock Exchange. Associated with Western Union. Ms(275) Me(1928) DIc RMSa

Teletypesetter Corp., 7 Dey St., New York, N. Y. / Rector 2-5651 /
Machines that set linotype at a distance. Ic RMSa

John E. Thompson and Associates, 7210 So. Yates Ave., Chicago 49, Ill. *C
Ss(10) Se(1946) Ac Ma

Ultrasonic Corp., 640 Memorial Drive, Cambridge, Mass. / University 4-5400 / *C

Automatic control using feedback: development, equipment. Computing controls for machine tools. Etc. Ls(700) Se(1945) DASc RMSa

Underwood Corp., One Park Ave., New York 16, N.Y. General Research Lab., 56 Arbor St., Hartford 6, Conn.; and elsewhere / Lexington 2-7000 / *C
Accounting machines, adding machines, typewriters. Elliott-Fisher and Sundstrand machines. Underwood electric typewriters, used in Harvard Mark II calculator. ELECOM electronic computers. SEE Electronic Computer Division of Underwood Corporation. Ls(company 10,000; laboratory, 100) Le(1895) DIc RMSa

Union Switch and Signal Co., Division of Westinghouse Airbrake, Pittsburgh 18, and Swissvale, Pa. Railroad signaling and control systems. Ls (4000) Le Ic RMSa

U. S. Air Force, Aeronautical Research Laboratory, Computation Branch, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio (formerly Office of Air Research) *C
Assembling a computing laboratory. Has Oarac. Ms Se(1946) DACMc GRPa

U. S. Air Force, Cambridge Research Center, 230 Albany St., Cambridge 39, Mass. / University 4-4720 /
Developed the ABC (Automatic Binary Computer). Has a Computer Research Corp. 102. Ms Me DIc Ga

U. S. Air Force, Inst. of Technology, Wright-Patterson Air Force Base, Dayton, Ohio. *C
Electronic strategy machine, conceived by L. I. Davis. Philbrick and Reac equipment on hand. Ms(300) Se(1946) DAIc Ga

U. S. Army, Ballistic Research Laboratories, Aberdeen Proving Ground, Aberdeen, Md. *C
Has Bell, Edvac, Eniac, Ordvac computers and others. Developing supplementary and modernizing components. Ms Le DAc Ga

U. S. Naval Proving Ground, Computation and Ballistics Department, Dahlgren, Va. *C
Has Harvard Mark II relay and Mark III electronic digital computers. Digital and analog machines. Ms(116) Se(1942) DAc PRGa

U. S. Naval Research Laboratory, Washington 25, D. C. *C
Making NAREC digital computer. Ls(3000) Me DASc RCGPa

U. S. Navy, Office of Naval Research, Special Devices Center, Port Washington, New York / Port Washington 7-3800 /
Ls Me(1946?) DASc RMCGBa

Univ. Mathematical Laboratory, Free School Lane, Cambridge, England.
Has EDSAC electronic digital calculator. Dc RCPa

Univ. of California, Berkeley, Calif. *C
Constructing CALDIC, California Digital Computer. Ss(10) Se(1947) DAc RPa

University of Illinois, Urbana, Ill.
Built electronic digital computer Ordvac for Ballistic Research Laboratory, Aberdeen. Has finished computer Illiac on same design, but with faster input-output using a photoelectric reader. Dc RCPa

University of Manchester, Mathematical Laboratory, Manchester, England. *C
Has automatic electronic digital computer built by Ferranti Electric, Ltd. This laboratory developed much of the design. Ss(8) Se(1947) Dc RPa

Univ. of Michigan, Willow Run Research Center, Willow Run Airport, Ypsilanti, Mich. *C
Digital computers, both special purpose and general purpose, including Midac; electronic and electromechanical analog computers; simulators. Data-processing systems; analysis and computation using Midac; instruction in programming and numerical methods; simulation. Ls(500) Se(1946) DAc RCPa

University of Sydney, Dept. of Electrical Engrg., Section of Mathematical Instruments, Sydney, New South Wales, Australia
Analog computers. Ac Ra

Victor Adding Machine Co., 3900 No. Rockwell St., Chicago 18, Ill. *C
Adding machines. Ls(1600) Le(1918) Dc RMSa

Wallind-Pierce Corp., 1928 Pacific Coast Highway, Lomita, Calif. *C
Digital-to-analog, and analog-to-digital translators. Digital and analog computers, magnetic amplifiers, etc. Ss(18) Se(1951) DASc RCMSa

Wang Laboratories, 296 Columbus Ave., Boston 16, Mass. / Kenmore 6-0624 / *C
Magnetic delay-line memory units. Digital signal generators. Multiple scalers. Static magnetic memory systems and other devices. Ss Se(1951) Dc RCMSa

The George Washington Univ., Logistics Research Project, 707 22nd St., Washington 7, D. C. *C
ONR relay computer with magnetic drum memory. Data-handling machines. Fast output. ONR electronic digital computer with magnetic drum memory. Ss Se(1949) Dc SRCPa

Watson Scientific Computing Laboratory, 612 West 116 St., New York, N. Y. / Monument 3-7518 / *C
The pure science department of International Business Machines. Simultaneous linear equation solver. Astronomical plate measuring machine. IBM punch card machines. Ms(75) Se(1945) DAc RCPa

Wayne University, Cass Ave., Detroit 1, Mich. *C
Computation laboratory. 5300-word magnetic drum computer built of Burroughs pulse control equipment. Has Mass. Inst. of Technology Differential Analyzer No. 1. Acquiring Bendix digital differential analyzer. Ss(20) Se(1950) DAc Ra

Jervis B. Webb Co., 8951 Alpine Ave., Detroit 4, Mich.
Conveyor engineers and manufacturers. Mc RCMSa

Weems System of Navigation, 227 Prince George St., Annapolis, Md.
Automatic navigation systems. Me Ic RCPMSa

Westinghouse Electric Corp., Industry Engineering Dept., East Pittsburgh, Pa. *C
Analog computers for: mechanical and electrical problems; regulating systems; servomechanism behavior; flow of heat, oil, or gas; other purposes. Dc and AC calculating boards. ANACOM computer. Ls Le DASc RMSCPa

Zator Co., 79 Milk St., Boston 9, Mass. / Liberty 2-4624 / *C
Equipment and systems, for coding, filing, and finding information (Zato-coding systems). High-speed selectors for notched cards. Methods for use of digital computing machines to recover information. Ss Se(1947) Ic RCSa

Zeuthen and Aagaard, Ltd., 6 Toldbodvej, Copenhagen, Denmark
Portable adding machine (Contex); dictating machine (Rex Recorder) with magnetic recording on plastic disc using impregnated magnetic particles and permitting 10,000 reuses; other office machines. ?s Le Ic RMSa

Konrad Zuse, Neukirchen, Germany
Has made Zuse Model IV computer. Se Dc RMSa

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ROSTER OF AUTOMATIC COMPUTING SERVICES

(Supplement, information as of March 10, 1954)

The purpose of this Roster is to report organizations (all that are known to us) offering automatic computing services and having at least one automatic computer. Each Roster entry contains: name of the organization, its address / analog or digital computation provided / notes on equipment / any restrictions as to clients.

This edition is a supplement to the cumulative edition published in the February, 1954 issue of "Computers and Automation", vol. 3, no. 2.

We shall be grateful for any additions or corrections that any reader is able to send us.

Some of the abbreviations are:

A, analog; D, digital

Cornell Computing Center, Rand Hall, Cornell University, Ithaca, N Y / D / IBM card programmed calculator, punch card / unrestricted

Rensselaer Polytechnic Institute, Computer Laboratory, Troy, N Y / A /
Reeves Electronic Analog Computer, precision magnetic tape recorders for analog computing applications / unrestricted

PATENTS

Hans Schroeder,
Milwaukee, Wisconsin

The following is a compilation of patents pertaining to computers and associated equipment from the Official Gazette of the United States Patent Office, dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention.

January 19, 1954: 2,666,576 / C J Hirsch, Douglaston, N Y / Hazeltine Research, Inc, Chicago, Ill / Electrical computer for solving equations involving series

2,666,912 / K P Gow, Pasadena, and A L Klein, Los Angeles, Calif / Calif Institute Research Foundation, Pasadena, Calif / Electrical counter; translates shaft rotations into digital pulses

January 26, 1954: (No applicable patents)

February 2, 1954: (No applicable patents)

February 9, 1954: 2,668,661 / G R Stibitz, Boonton, N J / Bell Tel Labs, Inc / New York, N Y / Relay computer handling complex numbers.

2,668,662 / W Roth, Cambridge, Mass / - / Integrating circuit using a motor which is driven by the plate current of a thyratron

2,668,875 / J O Shepherd, Atlanta, Ga /- /Electrical data recording system using fixed frequencies for storage of information on tape.

2,668,877 / E W Gent, Morristown, N J / Bell Tel Labs, Inc, New York, N Y / Electro-mechanical translator using punched cards to store vocabulary and instructions

February 16, 1954: 2,669,386 / W H Boghosian, Summit, H G Och, Short Hills, and B T Weber, Summit, N J / Bell Tel Labs, Inc, New York, N Y / Analog computer calculating gun data.

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THE EDITOR'S NOTES
(continued from page 4)

are not gagged; there are no new legal restraints. But there is the consciousness that to stray from the orthodox safety-zone is to invite sooner or later open denunciation or sly innuendo from the fanatics who make an organized business of intellectual vigilantism. Many people will trim their positions in the desire to avoid the calumny of the extremists.

In colleges and universities, it is much safer for both students and faculty members to refrain from becoming members of organizations, subscribing to publications, engaging in debates, that might at some future time be cited to show that they held dangerous -- or at least unpopular thoughts. Why take a risk? In conformity there is safety. The result of all this is a slow attrition of real intellectual freedom, and the worst effect may not be felt for many years to come.

The more or less subtle pressures against controversy are felt everywhere. They are so evident on the screen, in radio and television that it has become a positive act of courage to touch on anything that is "controversial". Worse than that. The moment that any actor or writer is attacked he becomes a "controversial" personality. The danger here is manifest. All one would have to do to get rid of an author or actor whom one didn't like would be to start a rumor that he had a politically questionable background. According to the standard that has become established, that makes the accused a "controversial figure", thus effectively ending his career.

In regard to the State Department, Norma Armour, Joseph C. Grew and three other outstanding former diplomats have written in an open letter "The conclusion has become inescapable that a Foreign Service officer who reports on persons and events to the very best of his ability and who makes recommendations which he conscientiously believes to be in the interest of the United States may subsequently find his loyalty and integrity challenged and may even be forced out of the service and discredited forever as a private citizen. A premium therefore has been put upon reporting and upon recommendations which are ambiguously stated or so cautiously set forth as to be deceiving."

Those who would restrict freedom are promoting what Senator Fullbright called " the swinish cult of antiintellectualism", most apparent in the attack on the freest centers of learning such as Harvard. They encourage a retreat from untrammeled expression and a flight from freedom of thought.

The only antidote to the influence these people exert, says Oakes, is a determination not to be frightened by them. There is no trick to recovering the full expression of freedom. But it requires the constant exercise of that privilege, for nothing atrophies from disuse so quickly. Americans in their hearts know this, and despite momentary aberrations have always come back to it.

The whole article by Oakes is well worth looking up and reading.

In the pages of this magazine we shall do our best to promote controversy, honorable controversy which truthfully and honestly explores ideas, and which tries to make sure that each side of a question is expressed fairly -- without calling names, attacking reputations, or hugging orthodoxy.

THE CONCEPT OF THINKING

Elliot L. Gruenberg,
The W. L. Maxson Corporation, New York

"The greatness of man consists in thought. Not from space must I seek my dignity, but from the ruling of my thought. ... By space the universe encompasses and swallows me as an atom; by thought I encompass it." —Pascal (1623-62), "Thoughts"

Few can quarrel with this expression by Pascal of the power and importance of some kinds of thinking. But is the concept of thinking here implied the same as the concept of thinking used by modern automators (i.e., persons who produce automation)?

In the "Wall Street Journal" of March 12, 1954, Mr. Kindeberger, Chairman of North American Aviation Co., is represented as believing that no complete conversion to pilotless intercepting planes is in the offing because "thus far no machine has been devised to replace the human mind in solving problems of judgment". Is judgment the essential of thinking?

Would we be further advanced in automation today if we had a standardized meaning for the word "thinking"? Such a standard meaning would have physically identifiable characteristics familiar to all who would design, use, and sell such machines. It should result in providing the same meaning to the corporation board chairman who raises the money for a thinking machine as it does to the draftsman designing it.

The delimiting of the meaning of thinking should serve a useful purpose. Possible objectives of such a definition are:

To explain human behavior
To find cures for human mental aberrations and diseases
To explain consciousness
To associate the thinking process with biological structure
To account for human evolution
To relate human beings with a religion or a vital force
To relate the evolution of mind with the evolution of biological life forms
To distinguish human beings from animals
To decide what is proper moral conduct
To determine ways of educating the young
To fix upon a meaning acceptable to all users of language

These have been some of the purposes of scientists and philosophers of the past in defining what they have meant by thinking. The purpose in their minds has often determined the resulting definition.

It would not be too surprising however if the definitions used by workers intent on different aims would not be altogether satisfactory for the aim of an automator. An automator's purpose in defining thinking is to help him to design devices which can replace human thinking in some way which is economically desirable. He need not be concerned with moral or ethical debates or explanations of humanity, but he does need a functional or operational definition.

Consider the definition of "think" in Webster's International dictionary:

> "form in mind; conceive; imagine, have a judgment of; believe; meditate or reflect upon, determine by reflection".

These definitions were devised to meet the last purpose stated above: to fix upon a meaning acceptable to all users of language. These definitions of course suffer from two opposing difficulties: on the one hand, being too broad to be of use for the precise job of designing a machine, or on the other hand, being too restrictive, not including all of the elements present in the thought process. Let us examine these definitions more closely.

"To conceive" denotes the determination of a new meaning. For this reason it is the broadest definition. But "to conceive" does not give any hint as to the operations involved.

"To form in mind" connotes the forming of mental images. This broadly defines <u>how</u> thinking is done but not why it is done nor what results.

"To imagine" defines a process in which the imaginer is able to have mental images which are not at that moment being received by sensory devices. But this definition is too restrictive; it says nothing about the judgment factor which is essential to purposeful thinking. "To have a judgment of" suffers from the opposite defect: it does not imply holding mental images in the mind.

"To meditate or reflect upon, to determine by reflection", are all useful definitions except for one thing: these definitions restrict the meaning of thinking specifically to an inward process of reflection before outward action is taken. But they say no more about the operations involved.

The definition "to believe" may be a result of loose usage of "to think", because if one believes, one does not resort to thinking. In other words, a purpose of thinking is to determine what to believe; hence, this definition seems to confuse ends with means.

We are led to the conclusion that none of these definitions completely define thinking in a way that could be used by one interested in designing a thinking machine. A concept that at minimum combines aspects of these definitions would approach the useful definition we are seeking.

It would be logical to turn to scientists for the definition we are seeking. We desire a precise, realistic definition expressed in terms of attributes, operations, and combinations of statements already accepted as believable by man.

Scientists have concerned themselves with thinking or mental activity from these viewpoints:

What structure in the human body is responsible for thinking?
How does human thinking differ from the thinking of animals? Is it only in degree or is it also in kind?
How did the mind evolve -- gradually or suddenly?
What is responsible for human behavior? for mental disturbances?

Scientists are chiefly concerned with the explanation of observable phenomena. Their method is to observe facts and then to postulate hypotheses or general theories. The consequences of these theories are considered in the light of known data and if all the cases fit, some credence is attached to the theory. However, the crucial test of a scientific theory is the prediction of particular consequences not previously observed. For example, the scientific model of the atom consists of a theory that has been subjected to a very large number of observations, and had predicted among other things the existence of chemical elements not previously known. Hence, one might say it is a good theory. As nuclear science develops making new observations, the scientific model of the atom needs new properties in order to explain the new observations. These have so far been added in a consistent way. But in regard to thinking, science has not evolved any very extensive theory which links the phenomena of the mind with those of matter. It has determined only a few structural links between mind and body, as for example that there is a definite region in the brain where sights are stored.

We might suspect, by drawing a logical conclusion to the preceding discussion, that scientists might eventually postulate a mind force to the atom just as they have endowed the atom with electrons, then neutrons, then electrons with spin, etc. But this will be done only in the interest of explaining and coordinating new observations of nature. One draws the inference that the viewpoint of scientists is often directed so much towards the details of phenomena that an all-pervading phenomenon such as thinking may elude their methods.

One branch of science closely related to the subject of thinking is psychology. One group of psychologists, known as Behaviorists, have made remarkable progress in explaining human behavior on the basis of the conditioned reflex. According to this theory, all knowledge and habits of mind are learned by the process of association in a manner similar to the famous experiment of Pavlov, wherein a dog learned to salivate at the ringing of a bell. This theory has not been able to explain well how babies are first able to make complete sentences without apparently going through a process of trial and error. It is also true that animals and human beings characteristically make complete solutions in solving simple problems. The ape figures out that he can get the bananas with the cane or he doesn't try. He does not try one possible solution after the other.

Another branch of science closely related to thinking is psychoanalysis. This science considers that the mind may be divided into two parts, the subconscious and the conscious, which is the part that deals with the real world. The phenomenon of hypnosis and other pehnomena are evidence of the existence of the subconscious. Unfulfilled or frustrated ideas slide down into the subconscious, into disuse but not dissolution. The subconscious is apparently unresponsive to anything but the criterion of pleasure and pain. The conscious or rational mind however is able to solve prob-

lems by setting up realistic criteria which are independent of self.

This concept of subconscious mind is a useful one in curing certain mental disorders traceable to emotional causes. These are detectable by exploring the subconscious. However, there seems to be no need to endow a "thinking" machine with a subconscious mind merely to simulate human thinking more closely. The machine need be concerned only with the rational solution of real problems.

Our exploration of the field of science of the present day has offered little help in the determination of the concept of thinking. Where can we turn then for our definition ? Or have we set an impossible task? As we have hinted, a broader view of the subject seems to be called for, a view that comes from those who make theories before all possible data are observed, those who seek to find a frame of reference that gives meaning to life as one finds it. Such a view is precisely within the province of the philosophers. These men have sought by reason to explain life; their views, when accepted, have found their way into the religions of the world. They could not escape forming some conception of the nature and function of the mind and of thinking. Perhaps from their ideas we can construct a meaning for thinking which can be standardized for purposes of automation.

The Greek philosophers were in search of "eudaimonia", which is a generalized form of happiness. They recognized three ways of achieving it, through intellect, feeling, or will. Socrates decided that through wisdom this happiness was achieved; hence, his dictum, "Know Thyself". Although determining the tissue of thinking was not their primary object, yet by emphasizing the intellectual life, these philosophers focused attention on thinking. Plato's concept, expressed in modern simile, was that ideas did not originate in the mind but rather were radiated like pictures from a motion-picture projector, and the individual provides a screen for these pictures by properly adjusting his mind; that is, ideas exist and men float into them.

Aristotle contributed two new concepts to this view. He discovered the associative method of learning, which is the foundation of modern psychology, and he laid down the principles of logic. Logic is often confused with thinking. Actually it is a discipline which has as its object the defining of rules for convincing others by reason. As such, logic does not relate directly to how the mind works or should work to think out a problem. It merely helps the mind to perceive relationships of ideas in a more exact fashion.

Francis Bacon was the first to point out that the classic Greek philosophers frequently did not relate many of their suppositions to reality. Scientific discoveries were beginning to be made which refuted some of the beliefs held as axiomatic on the authority of Aristotle. Bacon held that all conclusions should be put to the test of reality. He advocated the acquiring of new knowledge by an inductive process of comparing quantities and observing if they increase or decrease together. He thus did not completely anticipate the scientific process, for that involves setting up a hypothesis first and then testing it. In his "Novum Organon" he did study the errors of reasoning caused by the imperfections of the mind. These he called the idols of the mind; they are:

- The Idols of the Tribe: errors of humanity in general. These are distortions caused by ascribing to other things the properties of human beings.
- The Idols of the Cave: errors peculiar to the individual. "Every one has a cave or den of his own which refracts and discolors the whole."
- The Idols of the Market Place: errors arising from the association of men together. Here are anticipated the difficulties of language, the problems of semantics.
- The Idols of the Theatre: errors resulting from unquestioning adherence to a particular philosophic viewpoint, which usually rests upon a set of assumptions not easily related to reality.

This penetrating analysis of errors of perception led the philosopher Locke to base his view of life on the point that all our knowledge comes from experience and through our senses. This view is almost completely opposite to Plato's theory of ideas; and it led to a materialistic trend in Philosophy. For example, Hume reasoned that consciousness was no more than a series of sensations which required no concept of soul to help explain its existence. This position challenged Kant to produce his work "The Critique of Pure Reason". He argued that the sensations and suggestions which compose the tissue of thinking would be absolutely chaotic if there were not a mind, "a something else", to organize these perceptions into a unified existence. He based his argument on the existence of "pure reason", that is truths that are independent of the perceiver such as the truths of mathematics.

THE CONCEPT OF THINKING

The school of pragmatism divorces itself from consideration of the existence of a soul by concerning itself solely with that which can and should induce belief. Ideas are true if the consequences of changing the ideas are perceptible and real.

In my opinion, it remained for John Dewey to bring philosophy down to earth. Philosophy was not to be used to justify the supernatural but to help man relate to life. For Dewey, meaning was more fundamental than truth. To understand thinking, we must observe that it arises in specific situations. Reasoning begins not with premises but with difficulties; then it conceives a hypothesis for which it seeks the premises; finally it puts the hypothesis to the test. What could be a closer description of the useful kind of thinking in man?

Such a thought process can be specified by the following definition of thinking: "an operation in which present facts suggest other facts and induce belief in the suggested facts on the ground of the real relation in the things themselves." Belief, of course, is the basis for rational action. This is almost exactly John Dewey's own definition of thinking, which appears in his book "How We Think". It is this definition which the author used as a basis for deciding if a machine could be built to do reflective thinking (see "Reflective Thinking in Machines" in "Computers and Automation", Feb. 1954).

This definition has many advantages to the automator. It is specific, yet it describes the process completely. It is not related to the structure of the mind. It ignores the metaphysical questions of the existence of a mind force or the composition of consciousness. It does relate the process to experience. It implies how it is done; in other words it is operational.

Engineers are interested in the functioning of material things and how to put them to use to save effort. Many engineers of automation are interested in simulating thinking operations for useful purposes. Dewey's definition appears to be the clearest statement of the thinking function which our search of science and the philosophy of human understanding can uncover.

PUBLICATIONS

P25: NUMBLES—NUMBER PUZZLES FOR NIMBLE MINDS. Report. Contains collection of puzzles like:

```
      TRY
+   THESE
=   TWVAS

      HAVE
+      FUN
=    WASE

and    TRAIN      your
+       WITS
=     ENTNS

                WYE = VIF
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P14: CIRCUIT ALGEBRA—INTRODUCTION. Report. Explains simply a new algebra (Boolean algebra modified to include time) that applies to on-off circuits, using relays, electronic tubes, rectifiers, gates, flip-flops, delay lines, etc. Covers both static and sequential circuits. Applications to control, programming, and computing. Problems and solutions involving circuits.....$1.90

P16: SYMBOLIC LOGIC—TWENTY PROBLEMS AND SOLUTIONS. Report. Contains some problems by Lewis Carroll and John Venn (out of print), and many other new problems. Guide to using symbolic logic in actual situations.....$1.80

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GENERAL PURPOSE ROBOTS

Lawrence M. Clark,
Cambridge, Mass.

One of the theses advanced from time to time by engineers developing automation is that the automatic machines or robots resulting should not bear any necessary resemblance to human beings. When one is engaged, they say, in designing a new automatic process, one should become free from long habits of thought accepting the limitations that apply to human beings. One should "rethink" the process completely.

This thesis of course is true in many instances. For example, a machine for locomotion which would walk instead of roll on wheels would probably be much slower and more complicated than the ordinary wheeled motor car. For another example, a machine which is limited to about 3 or 4 reasoning operations per second, as a human being is, might be less useful for many purposes than a machine like the IBM 701 which can do more than 10,000 reasoning operations per second.

General Purpose Robots

But when more imaginative consideration is given to possible future applications of robots in civilization, the more evident it becomes that hundreds of thousands of places presently exist in civilization which are already suited for a general purpose robot, a robot which would resemble a human being in many ways but would be even more general purpose. The special purpose automaton for locomotion, the motor car, is quite generally limited to a paved surface, road. It requires, ordinarily, rather a large space about 6 feet wide and 16 feet long. But a general purpose robot should be able to go wherever a human being can go, and many more places besides. In addition, a general purpose robot should be able to reason either at the human rate of 3 or 4 operations a second, if desired, or faster or slower.

The word robot has now been used several times; there is more than one meaning for it; which meaning is being meant here? A robot according to the meaning used here is a machine which has perceptive apparatus, acting apparatus, and a programming apparatus, assembled together into an operating entity. In other words, a robot is a machine able to take some kind of appropriate action depending on its perception of its environment and the way in which the signals of the perceptions are combined to produce signals for its actions. A good example is the "responsive" traffic light: it perceives traffic by means of one or more treadles set in the pavement of the road; and it changes red and green lights in order to respond to the presence of traffic waiting to pass (see "Robot Traffic Policemen" in "Computers and Automation", July, 1953).

But why should anyone be interested in a general purpose robot, when all sorts of special purpose robots can be made, and very likely will be cheaper? For a single application, yes, a special purpose robot may well be cheaper. But for a number of different applications from time to time, a versatile robot, a general purpose robot, fairly easily interchangeable with a human being in many tasks yet more versatile, will be much more practical, and will require much less vigorous modification of the surrounding fabric of society.

Delivering a Message

For example, consider the problem of delivering a written telegram from a telegraph office, say at Boylston and Mount Auburn Streets, to a point five blocks away, say 15 Oxford St.

First, it is possible to imagine a recording instrument attached to everybody's telephone receiver; thus the clerk in the telegraph office would pick up his phone, dial the number at 15 Oxford St., speak the message into the receiver, and cause the message to be automatically recorded in a sound track. But it is definitely expensive to equip every telephone in the country with a recording device so that any desired message can be recorded; and even then the recording is not in written words but in stored sounds. Is there any other way?

Second, it is possible to imagine compressed air lines, pneumatic tubes, running

from the telegraph office to each of the neighboring addresses that this office serves. Along these tubes telegrams could be delivered automatically in capsules, as in some department stores transactions of various selling departments are delivered to a central cashier. But this system is far more expensive and inflexible even than the first system.

But it is possible to imagine a third method, a general purpose robot. The robot would receive the message in the telegraph office, put it in a container, travel by itself from the telegraph office to the delivery address, see possible collisions and avoid them, cross streets with due regard for traffic, recognize the address upon arrival, read the names on the bells, ring the right bell instead of the wrong bell, deliver the message, get a receipt, and return to the telegraph office.

This prospect of course seems at first glance a wild flight of imagination. But the capacities of this robot are general; it would be very useful in many areas besides message delivery; and the physical reality of these capacities is being foreshadowed by scientific and engineering work now under way.

What are the properties then that can be reasonably predicted for a general purpose robot, a robot that would resemble a human being but would have fewer limitations?

Size

In designing a general purpose robot, the first property that may be considered is size. How big should it be?

Present civilization is full of rather carefully measured spaces for physical travel. Doorways are about the height of a very tall man (7 feet) and about as wide as a very fat one (3 feet). Desks, tables, work benches are about 30 inches high, determined to be the right average height for a sitting man. Chairs are often adjustable, so that a person can be seated comfortably at the standard 30 inch height. Buses, trains, subways, sidewalks, etc., are all of a convenient size for accommodating 99 percent of human beings.

These conditions determine the size of a general purpose robot. For it should be able to move around without requiring society to re-engineer and rebuild all the travel spaces in civilization. Therefore, the robot should be about six feet high, two feet wide, a foot thick, and weigh up to about 220 pounds.

Energy and Fuel

One of the major problems to be solved for the robot is its supply of energy. It could probably be powered with an internal combustion motor, and be fueled with gasoline like a motor car. It is clear that the robot in most places cannot operate on a long cable, as the ordinary vacuum cleaner does; it is doubtful that it can run on power transmitted by wireless. A small efficient motor, a fuel tank, generators for providing electricity, and a storage battery would need to be included in the machine.

It is at once clear that the size, weight, and energy requirement is almost beyond present day engineering. But that is not too important, for the first general purpose robots will probably be used in factories or other work areas where a much larger size and weight are practical.

Travel

How would the general purpose robot move from place to place?

In order for the machine to be general purpose, it would in the first place have to have either three wheels like a tricycle or four wheels like a motor car. In this way it would be easy for it to move quickly over sidewalks or paved roads. But in addition it would be essential for the robot to have some apparatus like legs, or endless treads, so that it could ascend and descend stairs or ladders, and travel over rough ground -- through high grass, among bushes, over boulders and trails, through the woods.

It would have a gyroscopic balancing device, so that it would stay upright most of the time. And it would have facilities so that if it fell over, or if it were pushed over, it could "get up again" -- unlike the kind of beetle that, once it is on its back with legs waving in the air, cannot turn itself over.

Just as is the case with a human being, the general purpose robot could have attachments for special problems of travel: snowshoes, so that the machine could traverse snow; cleated boots or crampons, so that the machine could travel up and down steep rock or ice surfaces; a parachute, so that the machine could descend from a height through the air; etc.

Of course, in an application where the robot was used only in one place and had no need for travel, the motive equipment would either never be bought, or would be detached and stored in a closet until again wanted.

Grasping

The suppleness and versatility of a well-

trained pair of human hands are hardly anywhere displayed in general purpose machinery, although plenty of one-purpose machines can out-perform human hands. So a good deal of long hard engineering work would be required to design and build adequate hands and arms for a general purpose robot. Almost certainly however the machine would have at least three "hands," one of them being the equivalent of a table, anvil, or vise, on which work could be laid out and held for operations to be performed. Also, the machine would be able to replace one kind of hand or tool by another, and it would of course carry with itself spare hands or tools. The robot could handle sharp things without getting cut, hot things without being burned, heavy things without dropping them, etc.

Another important task in the design of the general purpose robot, which would certainly be difficult, is the programming of the hands and arms to do various kinds of useful operations. A human being has fingers, thumbs, hands and arms, which can touch something, feel it, take hold of it, lift it up, turn it over in several ways, put it down, let go of it, push it aside, or throw it some distance away.

These powers are so familiar to everybody that one often forgets how unusual and remarkable they are: hardly any animals have such facilities except apes, monkeys, elephants and squirrels; and man of course in the power to manipulate his hands exceeds all of his colleagues in the evolutionary scale. Other animals excel when it comes to the powers and skills of feet and legs; but human beings are supreme in the powers and skills of hands and fingers.

A baby spends a good deal of time learning how to do things with his hands, how to take hold, pick up, and handle things. The fact that he is able to do most of these things quite well long before he is able to talk shows that in evolutionary history, the ancestors of human beings very likely spent millenia developing the ability to manipulate and the instinct to be curious, before they developed language.

So in the construction of mechanical hands for a general purpose robot, one would have to provide for a variety of small motions and a number of perceptors. And the associating of the signals of perceptions and the signals for motions would need to be accomplished by a large quantity of elaborate, yet rather automatic programming within the machine.

Seeing and Hearing

A general purpose robot would need to be able to see. The perception of light or dark and of degrees of light and color have been accomplished in hardware, by "phototubes" and "photocells". Also, the scanning of two-dimensional surfaces and the reporting of light and dark at points over them has been accomplished by the "iconoscope", an electronic tube which is the heart of the television transmitter.

The "recognition" of a sight as matching with some previous sight has been begun, in work being done by David Shepard of Intelligent Machines Research Corporation, and probably by others. This is basically a process of comparing patterns reported by the scanning with patterns stored within the "memory" of the robot.

A general purpose robot would need to be able to hear. The perception of variations of sound has long been accomplished in hardware; "microphones" have even become common objects in the everyday world.

But the "recognition" of a sound as matching with some previously recorded sound is still apparently in early stages of development. Work is being done at Bell Telephone Laboratories, in the Acoustics Laboratory at Massachusetts Institute of Technology, and probably elsewhere on this project.

It seems likely that the first general purpose robots will be fairly well able to see but rather hard of hearing, by human standards.

Other Perceptions

Many kinds of scientific instruments detecting pehnomena (relative humidity, ultra violet light, air pressure, etc.) to which human beings are relatively insensitive already exist. Any of these instruments, if not too bulky, can be made part of the equipment of the general purpose robot.

On the other hand, taste and smell, in the particular degrees that human beings possess, may be very difficult to achieve. The wonderful possibilities of smell are revealed by animals like dogs and foxes having smelling organs far superior to those of human beings; here is a wide area for development of science and the general purpose robot.

Talking

The general purpose robot will be easily able to talk. On magnetic tape a hundred or five hundred or more appropriate sentences can be recorded by dictation, each with a key number. The machine could readily be programmed to calculate the key number according to a reasonable correlation between its perceptions and its mission (such as delivering the message

from the telegraph office), look up the associated message, and then utter it. In fact, there already exists a "stupid" machine which stores a single three-minute recorded message and says it over and over again for the benefit of passersby in a store. The same kind of machine gives automatic weather reports over the telephone.

Programming of the Robot

By "programming" is meant the reasonable association of: (1) signals coming from the robot's perceptors to the robot's control apparatus; and (2) signals issuing from the control apparatus to the robot's acting apparatus. Not only currently perceived signals will be operated with, but also past signals, which will be stored in a "memory". An extraordinary degree of such programming has been installed in automatic digital computers up to date. This has established beyond possibility of denial that very elaborate, reasonable interrelations between groups of signals may be inserted in the robot.

The method of insertion of instructions to the robots may be by punched paper tape or magnetic tape or in some other way that will transmit the instructions directly into the memory of the robot. It will not be necessary to rely on instructions "seen" by phototubes, or "heard" by microphones.

Construction

Are such machines as these possible of construction?

All of these properties together: not yet. But some of these properties together, and every one of these properties in at least an early and limited way: most certainly yes. Of course most people will not believe that general purpose robots are feasible within any short time. In fact it may well be ten years before the first rudimentary general purpose robot able to deliver a message comes into existence. But impossibility has an odd way of becoming possible, as the utilization of atomic energy has proved.

It is also clear that a great amount of miniaturization of hardware and of arduous engineering is necessary before the first fairly general purpose robots of the message level can be expected to come into existence.

Many useful intermediate products however lie along the road ready to be picked up. For n abilities of general purpose robots can be combined in 2^n ways, including or excluding any one, while the n abilities of a human being are issued only in one single package, all of them together.

Other Questions

In a discussion of general purpose robots many other questions can be brought up and often are: do they have a brain? will they think? can they have emotions? will they have independent will? etc.

These questions, or rather the arguments resulting, have a tendency to be full of sound and fury. For the purposes of the present discussion however it is not necessary to argue these questions. The general purpose robots that will be constructed in the future will have a tendency to dispose of the arguments very completely.

Forum:

A COMPANY DESIRING INFORMATION

From Isador Pardo, C.I.T. Financial Corp., One Park Avenue, New York 16, N. Y.:

First, I would like to say that I have been a reader of your publication "Computers and Automation" ever since it first came out and that I have enjoyed reading every issue. I have found it very informative and packed with a wealth of information that is obtainable nowhere else in such convenient and readable form. Keep up the good work.

Commercial Investment Trust, Inc., is currently conducting an intensive research program into the possible utilization of the latest electronic data-processing equipment in connection with large-scale accounting procedures.

We are extremely interested in obtaining the most recent information regarding such devices and making contact with the proper people connected with the development of this equipment.

At present we are in contact with ((he names four companies)) ...

We thank Mr. Pardo for his kind comments.

Will anyone having the type of information Mr. Pardo is seeking please send it to him?

If other people desire to receive information, we shall be glad to publish their names.

-- Editor

Forum:

AUTOMATION IN THE KITCHEN -- A COMMENT

From Sgt. Luther M. Jenkins, Camp Zama, Japan:

As a layman who doesn't know the difference between a digital computer and an analog computer, please allow me to add my penny's worth of congratulations for a fine magazine. Put me down for another year on your subscription list ...

Would you tell your contributing editor, Fletcher Pratt, that I agree with him in his article, Automation in the Kitchen ? (I like his science-fiction, too). But there are many different ways to prepare food and not the best chef in the world can tell exactly what you want done to your food. Ask Mr. Pratt to leave room for a little originality. ...

Forum

ANSWERS TO "PUZZLES FOR COMPUTERS"

From S. S. Macks, Baltimore, Maryland:

Please furnish answer to "Puzzles for Computers" on page 4 of January, 1954, issue of "Computers and Automation".

The first puzzle was "H A P P Y D A Y" The wish was "We trust you will have many 9065150046521". The letters in the order 0 to 9 are X, S, R, P, Y, A, E, H, D, M. The literal translation of the figures is "mx-easaxx years"; it includes a misspelling with "m" instead of "p" to throw persons accustomed to solving cryptograms off the track; and the meaning rather clearly is "We trust you will have many pleasant years."

The second puzzle was based on a "A W E R Y M E R R Y C H R Y S M A S". N and P were the same digit as M. The wish was "We wish you 89868024". The letters in the order 0 to 9 are S, C, R, H, E, B, Y, W, M or N or P, A. The translation of 89868024 is "M or N or P, A, M or N or P, Y, M or N or P, O, R, E;" and this fairly clearly is "many more".

The third puzzle was "H A P P Y" divided into "N E W Y E A R S". W is the same digit as N. The wish was "We hope you have 9716859641707930". The letters in the order 0 to 9 are S, R, H, X, P, A, Y, E, M, N or W. The literal translation of the wish is N orW, E, R, Y, M, A, N or W, Y, P, R, E, S, E, N or W, X, S and the meaning fairly clearly is "very many presents".

If any one is entertained by these puzzles or curious about the method of solution, he may wish to obtain from us "Numbles -- Number Puzzles for Nimble Minds". This publication contains a collection of puzzles of this kind, and ten pages of information on how to solve this kind of puzzle. See the announcement on page 21.

Forum:

JOURNAL OF THE ASSOCIATION FOR COMPUTING MACHINERY

From: J. M. Weinbach , Cie. IBM France, 20 Avenue Général-Michel-Bizot, Paris XIIe, France:

"In your paper on the meeting of the A. C.M. published in page 17 of the October issue of "Computers and Automation", you stated that a quarterly journal would be sent from January 1st 1954 to all people applying for membership to Mr. E. Bromberg, Institute of Mathematical Sciences, New York University, 25 Waverly Place, New York 3.

"Our bookseller, Technique et Documentation, 11, Rue Lavoisier, Paris 8, and ourselves have written three letters and sent a check of $6. to the above mentioned address since the last 13 of November, and have received no answer.

"Kindly tell us, as soon as possible, if there was no mistake in your paper in Computers and Automation and if we can expect to receive the quarterly journal in which we are interested."

There is no mistake. The first issue of the "Journal of the Association for Computing Machinery" arrived in our mail on March 15. This issue, Vol. 1 No. 1, contains seven papers, a page of news and reports, and a reprint of the "Office of Naval Research Digital Computer Newsletter" for January , 1954.

Communications on business matters should be addressed to the Association for Computing Machinery, 2 East 63 St., New York 21, N. Y. It is hoped that now that the association has permanent headquarters with the New York Academy of Sciences, prompt replies will reach inquirers regularly.

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Forum:

BUREAU OF CENSUS UNEMPLOYMENT FIGURES FROM UNIVAC

From John E. Parker, Vice President Electronic Computer Department, Remington Rand, New York:

... To keep you and your colleagues informed on the very newest employment shifts, the U. S. Bureau of Census publishes its "Monthly Report on the Labor Force". The story of how and why this comprehensive report is compiled is covered in detail in the enclosed reprint from "The Wall Street Journal". ... Univac makes it possible for the Census Bureau to produce this report in twenty hours or less. ....

From "The Wall Street Journal", Jan. 28,1954:

... Every month attendants feed Univac a batch of figures collected in a spot check of 25,000 U.S. households by 300 Census Bureau doorbell ringers. In a matter of 20 hours or less, the "brain" comes up with figures purporting to show how many people in the United States are at work, how many job-hunting, their age and sex, the number of part and full time workers, farmers and non-farmers. ...The 25,000 households are scattered through 125 counties in 42 states. These targets have been picked to provide a cross section of population. ...Only people 14 years of age or older are counted, and the make-up of the sample is "rotated" from time to time. ...

A person is rated employed if he did even a single hour of work for pay during the week, or if he worked 15 hours or more without pay in a family enterprise, or had a job but was idle because of sickness, a strike, bad weather, or vacation. He is "employed" even if laid off from work by his employer, so long as the boss has given him a definite promise of returning to work within 30 days. ...

Idle people who have no jobs and don't want one, are counted as not being in the "labor force". This would include students, housewives, and the aged and infirm among others.

The results of the spot check are mailed to the Census Bureau at Suitland, Md. and transposed to punch cards. These are then converted to magnetic tape which can be fed to Univac. The machine does the calculations necessary to inflate the sample into a nation-wide total, and produces neatly typed tables giving the detailed results....

The complaints about this process have not centered on Univac's mathematical prowess, nor even the validity of the Census Bureau's sampling. ...What most bothers the critics of the labor force report is ... the definition the Bureau uses for unemployment. Specifically, CIO officials claim that people who are employed only a small fraction of the week should be listed among the jobless. Union spokesmen claim that under the questioning system used by the Census, people working part time but actually looking for full time jobs never get a chance to tell the enumerator their troubles; they're automatically listed among the employed with no more questions asked. ... Furthermore the unions argue that the questioning technique isn't penetrating enough to reach people who are out of work and not looking for work, but who would be willing to work if jobs were plentiful. ...

To all this the Census Bureau has a ready answer: The figures on part time employment are no secret; they're supplied with each report; how much importance is attached to them is not up to the Bureau to decide....

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Please send me additional information on the following subjects for which I have circled the CA number:

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January, 1953: Brains: Electronic and Otherwise -- A. S. Householder
What Computers Do — S. B. Williams
The Parameters of a Business Problem in Reading — C. H. Dent
Automatic Computers on Election Night -- E. F. Murphy and E. C. Berkeley
March: Gypsy, Model VI, Claude Shannon, Nimwit, and the Mouse — George A. W. Boehm, Science Editor, Newsweek
Water and Computers -- Henry M. Paynter, Jr., Mass. Inst. of Technology, and Neil Macdonald
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The ERA 1103 Automatic Computer -- Neil Macdonald
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September: The Soviet Union: Automatic Digital Computer Research -- Tommaso Fortuna
Digital Computer Questionnaire -- Lawrence Wainwright
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Roster of Organizations in the Field of Computers and Automation / Roster of Automatic Computing Services / Roster of Organizations Making Components / List of Automatic Computers / Who's Who in the Field of Computers and Automation / Books and Other Publications/ Glossary / Patents

Price of back copies, if available, $1.25 each.

A subscription (see rates on page 4) may be specified to begin with any issue from January, 1954, to date.

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Glossary of Terms in the Field of Computers and Automation (from three 1953 issues) -- 60 cents

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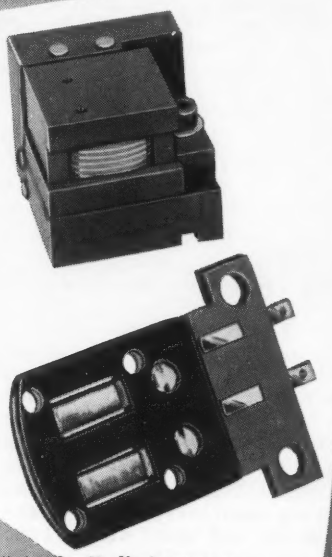

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Memorandum from Edmund C. Berkeley and Associates
Publishers of COMPUTERS AND AUTOMATION
36 West 11 St., New York 11, N.Y.

1. What is "COMPUTERS AND AUTOMATION"? It is a magazine published monthly, except June and August, containing articles and reference information related to computing machinery, robots, automatic controllers, cybernetics, automation, etc. One important piece of reference information published is the "Roster of Organizations in the Field of Computers and Automation". The basic subscription rate is $4.50 a year in the United States. Single copies are $1.25. The magazine was called THE COMPUTING MACHINERY FIELD until the March, 1953, issue; prior to that issue, it was published less often than ten times a year.

2. Who are the logical readers? The logical readers of COMPUTERS AND AUTOMATION are some 4000 persons who are concerned with the field of computers and automation. Many people are entering this field all the time. These include a great number of people who will make recommendations to their organizations about purchasing computing machinery, similar machinery, and components, and whose decisions may involve very substantial figures. We have been carefully gathering the names and addresses of these people for some time and believe we can reach them. The print order for the April issue was 1700 copies. The paid subscriptions on February 10, 1953 were a little over 1100. The overrun is largely held for eventual sale as back copies.

3. What type of advertising does COMPUTERS AND AUTOMATION take? The purpose of the magazine is to be factual and to the point. For this purpose the kind of advertising wanted is the kind that answers questions factually. We recommend for the audience that we reach, that advertising be factual, useful, interesting, understandable, and new from issue to issue. We have had a number of comments expressing satisfaction with our style of advertising.

4. What are the specifications and cost of advertising? COMPUTERS AND AUTOMATION is published on pages 8½" by 11" and produced by photooffset. The closing date for any issue is approximately the 10th of the month preceding. If possible, the company advertising should produce final copy, which should be actual size and assembled, and may include typing, writing, line drawings, printing, screened halftones, etc. — any copy that may be photoffset without further preparation. If inconvenient to produce this, we will take rough copy and arrange with the printer to prepare it; there will be small additional charges in this event. Display advertising will be sold in units of full pages (ad size 7" by 10", basic rate $130), and half pages (basic rate $70); back cover, $250; inside front and back cover, $160. Extra for color red (full pages only) 25%. Classified advertising will be sold by the word (40 cents a word), with a minimum of ten words.

5. Who are our advertisers? Our advertisers in recent issues have included the following companies, among others:

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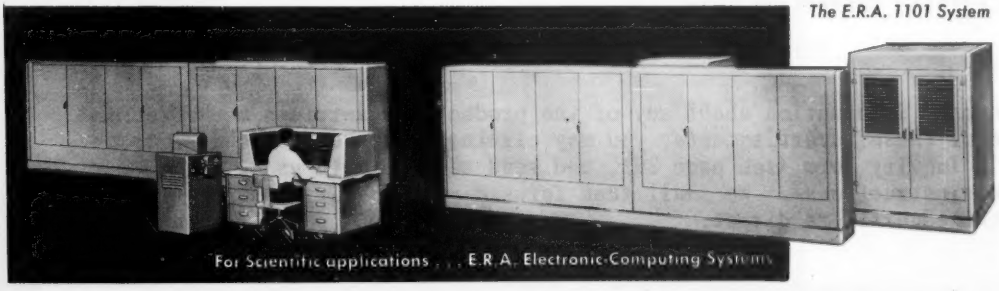
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Electronic Computer Department, Room 1423, 315 Fourth Ave., N. Y. 10, N. Y.

ADVERTISING INDEX -- APRIL, 1954

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose, the kind of advertising we desire to publish is the kind that answers questions, such as, What are your products? What are your services? And for each product, What is it called? What does it do? How well does it work? What are its main specifications? Adjectives that express opinion are not desired. We reserve the right not to accept advertising that does not meet our standards.

Every advertisement in this issue, we believe, is factual and objective. For these reasons, we think that the advertising is likely to be worth reading. So far as we can tell, the statements made are reasonable, informative and worth considering.

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If you wish more information about any of the products or services mentioned in one or more of these advertisements, you may circle the appropriate CA No.'s on the Reader's Inquiry Form (see page 29), and send that form to us -- we pay postage (see the instructions). We shall then forward your inquiries, and you will hear from the advertisers direct.